TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

OCT 29 2008

ANALYTICAL REPORT

Job Number: 360-19376-1

Job Description: A 0308-7-03

For:
Tighe & Bond
53 Southampton Road
Westfield, MA 01085

Attention: Jeffery Thelen

Joseph A. Chimi Jr.

Approved for release.
Joe Chimi
Report Production Representative
10/28/08 2:40 PM

Designee for
Lisa A Worthington
Project Manager II
lisa.worthington@testamericainc.com
10/28/2008

The test results in this report meet all NELAC requirements for accredited parameters. Any exceptions to NELAC requirements are noted in this report. Pursuant to NELAC, this report may not be reproduced except in full, and with written approval from the laboratory.

TestAmerica Westfield Certifications and Approvals: MADEP MA014, RIDOH57, CTDPH 0494, VT DECWSD, NH DES 2539, NELAP FL E87912 TOX, NELAP NJ MA008 TOX, NELAP NY 10843, NY DOH 10843.

Field sampling is performed under SOPs WE-FLD-001 and WE-FLD-002.

METHOD SUMMARY

Client: Tighe & Bond

Job Number: 360-19376-1

Description	Lab Location	Method	Preparation Method
Matrix: Water			
Metals (ICP/MS)	TAL WFD	SW846 6020	
Sample Filtration, Field	TAL WFD		FIELD_FLTRD
Total Cyanide (Automated Colorimetric]	TAL WFD	SW846 9012A	
Cyanide, Total and/or Amenable, Distillation	TAL WFD		SW846 9012A

Lab References:

TAL WFD = TestAmerica Westfield

Method References:

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

METHOD / ANALYST SUMMARY

Client: Tighe & Bond

Job Number: 360-19376-1

Method	Analyst	Analyst ID
SW846 6020	Smith, Tim J	TJS
SW846 9012A	Lalashius, Andrew L	ALL

SAMPLE SUMMARY

Client: Tighe & Bond

Job Number: 360-19376-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
360-19376-1	SW-15	Water	10/15/2008 1410	10/15/2008 1555
360-19376-2	SW-15A	Water	10/15/2008 1400	10/15/2008 1555
360-19376-3	SW-15B	Water	10/15/2008 1430	10/15/2008 1555

Jeffery Thelen
Tighe & Bond
53 Southampton Road
Westfield, MA 01085

Job Number: 360-19376-1

Client Sample ID: SW-15
Lab Sample ID: 360-19376-1

Date Sampled: 10/15/2008 1410
Date Received: 10/15/2008 1555
Client Matrix: Water

Analyte	Result/Qualifier	Unit	MDL	RL	Dilution
Method: Dissolved-6020		Date Analyzed:	10/21/2008 1546		
Lead	1.8	ug/L	0.29	1.0	1.0

Jeffery Thelen
Tighe & Bond
53 Southampton Road
Westfield, MA 01085

Job Number: 360-19376-1

Client Sample ID: SW-15
Lab Sample ID: 360-19376-1

Date Sampled: 10/15/2008 1410
Date Received: 10/15/2008 1555
Client Matrix: Water

Analyte	Result/Qualifier	Unit	RL	RL	Dilution
Method: 9012A		Date Analyzed:	10/27/2008 1456		
Prep Method: 9012A		Date Prepared:	10/27/2008 1144		
Cyanide, Total	ND	mg/L	0.0060	0.0060	1.0

Jeffery Thelen
Tighe & Bond
53 Southampton Road
Westfield, MA 01085

Job Number: 360-19376-1

Client Sample ID: SW-15A
Lab Sample ID: 360-19376-2

Date Sampled: 10/15/2008 1400
Date Received: 10/15/2008 1555
Client Matrix: Water

Analyte	Result/Qualifier	Unit	MDL	RL	Dilution
Method: Dissolved-6020		Date Analyzed:	10/21/2008 1548		
Lead	14	ug/L	0.29	1.0	1.0

Jeffery Thelen
Tighe & Bond
53 Southampton Road
Westfield, MA 01085

Job Number: 360-19376-1

Client Sample ID: SW-15A
Lab Sample ID: 360-19376-2

Date Sampled: 10/15/2008 1400
Date Received: 10/15/2008 1555
Client Matrix: Water

Analyte	Result/Qualifier	Unit	RL	RL	Dilution
Method: 9012A		Date Analyzed:	10/27/2008 1457		
Prep Method: 9012A		Date Prepared:	10/27/2008 1144		
Cyanide, Total	0.035	mg/L	0.0060	0.0060	1.0

Jeffery Thelen
Tighe & Bond
53 Southampton Road
Westfield, MA 01085

Job Number: 360-19376-1

Client Sample ID: SW-15B
Lab Sample ID: 360-19376-3

Date Sampled: 10/15/2008 1430
Date Received: 10/15/2008 1555
Client Matrix: Water

Analyte	Result/Qualifier	Unit	MDL	RL	Dilution
Method: Dissolved-6020		Date Analyzed:	10/21/2008 1551		
Lead	7.4	ug/L	0.29	1.0	1.0

Jeffery Thelen
Tighe & Bond
53 Southampton Road
Westfield, MA 01085

Job Number: 360-19376-1

Client Sample ID: SW-15B
Lab Sample ID: 360-19376-3

Date Sampled: 10/15/2008 1430
Date Received: 10/15/2008 1555
Client Matrix: Water

Analyte	Result/Qualifier	Unit	RL	RL	Dilution
Method: 9012A		Date Analyzed:	10/27/2008 1458		
Prep Method: 9012A		Date Prepared:	10/27/2008 1144		
Cyanide, Total	ND	mg/L	0.0060	0.0060	1.0

Login Sample Receipt Check List

Client: Tighe & Bond

Job Number: 360-19376-1

Login Number: 19376
Creator: Rinard, Kimberley A
List Number: 1

List Source: TestAmerica Westfield

Question	T / F/ NA	Comment
Radioactivity either was not measured or, if measured, is at or below background	N/A	
The cooler's custody seal, if present, is intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	1.0 C / 6.0 C
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	N/A	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	

SAMPLE COLLECTION DATA SURFACE WATER

Client: TIGHE & BOND
53 SOUTHAMPTON RD
WESTFIELD MA

Job Number: A-308
Sampling Location: OLD AMHERST L.F.
SW-15

Contact: JJT
Collected By: AM
Date: 10/15/08
Time Collected: 1410

Weather: Sunny 60°F

Sampling Method:

Surface:
Stainless Steel Bucket:
Bottle: X
Other:

Sample Type: Grab: X
Composite: ______ if so describe

FIELD DATA

pH	Dissolved Oxygen mg/L	Specific Conductance µmhos/cm @25°C	Temperature °C	Residual Chloride mg/L	—	Time Analyzed
—	—	—	—	—	—	—

CONTAINERS & PRESERVATIVES

Type of Container	Number of Containers	Preservative Type/Amount	Analysis Required	Field pH
250mL pl	1	HNO_3	DISS. pb	<2
250mL pl	1	NaOH	CN	>12

If sample was taken for dissolved metals, were these samples field filtered? YES

Date: 10-15-08 Time: 1415 By: AM Filter Pore Size & Type: 0.45 MICRON GELMAN

General Notes:

SAMPLE COLLECTION DATA SURFACE WATER

Client: TIGHE + BOND
53 SOUTHAMPTON RD
WESTFIELD MA

Job Number: A-308

Sampling Location: OLD AMHERST L.F.
SW-15A

Contact: JJT

Collected By: CM Date: 10/15/08 Time Collected: 1400

Weather: Sunny 60°F

Sampling Method:

Surface: ______ Bottle: X

Stainless Steel Bucket: ______ Other: ______

Sample Type: Grab: X Composite: ______ if so describe

FIELD DATA

pH	Dissolved Oxygen mg/L	Specific Conductance µmhos/cm @25°C	Temperature °C	Residual Chloride mg/L	—	Time Analyzed
—	—	—	—	—	—	—

CONTAINERS & PRESERVATIVES

Type of Container	Number of Containers	Preservative Type/Amount	Analysis Required	Field pH
250mL pl	1	HNO_3	Diss. Pb	<2
250mL pl	1	NaOH	CN	>12

If sample was taken for dissolved metals, were these samples field filtered? YES

Date: 10-15-08 Time: 1405 By: CM Filter Pore Size & Type: 0.45 MICRON GELMAN

General Notes:

SAMPLE COLLECTION DATA SURFACE WATER

Client: TIGHE + BOND
53 SOUTHAMPTON RD
WESTFIELD MA
Contact: JJT
Collected By: AM Date: 10/15/08

Job Number: A-308
Sampling Location: OLD AMHERST L.F.
SW-15B.
Time Collected: 1430

Weather: SUNNY 60°F

Sampling Method:

Surface: ______ Bottle: X
Stainless Steel Bucket: ______ Other: ______

Sample Type: Grab: X Composite: ______ If so describe

FIELD DATA

pH	Dissolved Oxygen mg/L	Specific Conductance µmhos/cm @25°C	Temperature °C	Residual Chloride mg/L	—	Time Analyzed
—	—	—	—	—	—	—

CONTAINERS & PRESERVATIVES

Type of Container	Number of Containers	Preservative Type/Amount	Analysis Required	Field pH
250ml pl	1	HNO3	Diss. Pb	<2
250ml pl	1	NaOH	CN	>12

If sample was taken for dissolved metals, were these samples field filtered? YES

Date: 10-15-08 Time: 1435 By: AM Filter Pore Size & Type: 0.45 MICRON GELMAN

General Notes:

TestAmerica Laboratories, Inc.
Chain of Custody Form

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

•53 Southampton Road
Westfield, MA 01085
(P) 413-572-4000
(F) 413-572-3707

•148 Rangeway Road
N. Billerica, MA 01862
(P) 978-667-1400
(F) 978-667-7871

360 19376

Job#: ______ Quote#: ______ PO#: ______ (Shaded areas for office use)

Client: Tighe &Bond
Address: 53 Southampton Rd.
Westfield, MA 01085
Phone: 413-562-1600 Fax:

Job#: A 0308-7-03
Project Manager:
Work ID: Old Amherst LF
Contact: Jeff Thelen

Requested Turn Around Time
15 Business Day ____ Rush ____
10 Business Day ____ Other ____

NPDES ____ Drinking Water ____ MCP Other ____
RCRA ____ MCP GW1 ____ Other ____

Analysis Requested
Check analysis and specify method and analytes in comments section.
For example:
500-series for drinking water
600-series for waste water
8000-series for haz/solid waste
Use comments section to further define.

Comments
(Special Instructions)
1. CN
2. Diss: Pb

Sample Type Codes
WW-Wellwater W-Wastewater SW-Surfacewater LW-Labwater
RW-Raw Water GW-Groundwater PW-Public Water SO-Soil
S-Solid SL-Sludge O-Oil A-Air Z-Other

Sample ID	Sample Type	Sampler's Initials	Date Time Collected	Grab	Comp.	# Containers	Plastic(P) or Glass(G)	NaHSO4/MeOH	HNO3 to pH <2	H2SO4 to pH <2	HCl to pH <2	NaOH to pH >2	Other:	4° C	pH	Volatiles	Semivolatiles	PCB & Pesticides	EPH	VPH	DRO/GRO (circle)	Oil & Grease	Metals	General Chemistry	Bacteriological	Other
SW-15	SW	AM	10-15-08 1410	X								X												1		
SW-15	SW	AM	↓	X					X														2			

10/15/08

Sampled by (print): ADAM MARSHALL
Signature:
Relinquished by: [signature] Date: 10-15-08 Time: 1555
Received by: [signature] Date: 10/15/08 Time: 1555
Relinquished by: Date: Time:
Received by: Date: Time:
Method of shipment: TestAmerica Laboratories

Cooler#: [illegible]
Temp @ receipt: [illegible]
Preservation/pH checked:
By: [illegible] Date: [illegible]

Page 1 of 1

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TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

360 19376

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(F) 413-572-3707

•148 Rangeway Road
N. Billerica, MA 01862
(P) 978-667-1400
(F) 978-667-7871

Job#: | Quote: | PO#: (Shaded areas for office use)

Client: Tighe &Bond
Address: 53 Southampton Rd.
Westfield, MA 01085
Phone: 413-562-1600 Fax:

Job#: A 0308-7-03
Project Manager:
Work ID: Old Amherst LF
Contact: Jeff Thelen

Requested Turn Around Time
15 Business Day ______ Rush ______
10 Business Day ______ Other ______

NPDES ______ Drinking Water ______ MCP Other ______
RCRA ______ MCP GW1 ______ Other ______

Analysis Requested
Check analysis and specify method and analytes in comments section.
For example:
500-series for drinking water
600-series for waste water
8000-series for haz/solid waste
Use comments section to further define.

Comments (Special Instructions)
1. CN
2. Diss: Pb

Sample Type Codes
WW-Wellwater W-Wastewater SW-Surfacewater LW-Labwater
RW-Raw Water GW-Groundwater PW-Public Water SO-Soil
S-Solid SL-Sludge O-Oil A-Air Z-Other

Sample ID	Sample Type	Sampler's Initials	Date Time Collected	Grab	Comp.	# Containers	Plastic(P) or Glass(G)	NaHSO4/MeOH	HNO3 to pH <2	H2SO4 to pH <2	HCl to pH <2	NaOH to pH >2	Other:	4° C	pH	Volatiles	Semivolatiles	PCB & Pesticides	EPH	VPH	DRO/GRO (circle)	Oil & Grease	Metals	General Chemistry	Bacteriological	Other
SW-15A	SW	CM	10-15-08 1400	X								X												1		
SW-15A	SW	CM	↓	X					X														2			

10/15/08

Sampled by (print): CHARLIE MOON
Signature: Charlie Moon
Relinquished by: Charlie Moon Date: 10-15-08 Time: 1555
Received by: [signature] Date: 10/15/08 Time: 1555
Relinquished by: Date: Time:
Received by: Date: Time:
Method of shipment: TestAmerica Laboratories

Code:
Temp @ receipt:
Preservation/pH checked
By: Date:

Page 1 of 1

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Q:/qaqc/dcontrol/SMF00500.MA

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(F) 978-667-7871

360 19376

Job#: | Quote#: | PO#:

Client: Tighe &Bond
Address: 53 Southampton Rd.
Westfield, MA 01085
Phone: 413-562-1600 Fax:

Job#: A 0308-7-03
Project Manager:
Work ID: Old Amherst LF
Contact: Jeff Thelen

Requested Turn Around Time
15 Business Day ______ Rush ______
10 Business Day ______ Other ______

NPDES ______ Drinking Water ______ MCP Other ______
RCRA ______ MCP GW1 ______ Other ______

Sample Type Codes
WW-Wellwater W-Wastewater SW-Surfacewater LW-Labwater
RW-Raw Water GW-Groundwater PW-Public Water SO-Soil
S-Solid SL-Sludge O-Oil A-Air Z-Other

Shaded areas for office use

Analysis Requested
Check analysis and specify method and analytes in comments section.
For example:
500-series for drinking water
600-series for waste water
8000-series for haz/solid waste
Use comments section to further define.

Comments
(Special Instructions)
1. CN
2. Diss: Pb

Sample ID	Sample Type	Sampler's Initials	Date Time Collected	Grab	Comp.	# Containers	Plastic(P) or Glass(G)	NaHSO4/MeOH	HNO3 to pH <2	H2SO4 to pH <2	HCl to pH <2	NaOH to pH >2	Other:___	4° C	pH	Volatiles	Semivolatiles	PCB & Pesticides	EPH	VPH	DRO/GRO (circle)	Oil & Grease	Metals	General Chemistry	Bacteriological	Other___
SW-15B	SW	AM	10-15-08 1430	X								X												1		
SW-15B	SW	AM	↓	X					X														2			

10/15/08

Sampled by (print): ADAM MARSHALL
Signature:
Relinquished by: Charlie Moon Date: 10-15-08 Time: 1555
Received by: Date: 10/15/08 Time: 1555
Relinquished by: Date: Time:
Received by: Date: Time:
Method of shipment: TestAmerica Laboratories

Cooler:
Temp @ receipt:
Preservation pH checked:
Date:

Page 1 of 1

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O:\qaqc\...\SMF... MA

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

Sed-1 Hg ✓

RECEIVED
JUL 10 2008
TIGHE & BOND

ANALYTICAL REPORT

Job Number: 360-17421-1

Job Description: A-0308

For:
Tighe & Bond
53 Southampton Road
Westfield, MA 01085

Attention: Jeffery Thelen

Joseph A. Chieco Jr.

Designee for
Lisa A Worthington
Project Manager II
lisa.worthington@testamericainc.com
07/09/2008

The test results in this report meet all NELAC requirements for accredited parameters. Any exceptions to NELAC requirements are noted in this report. Pursuant to NELAC, this report may not be reproduced except in full, and with written approval from the laboratory. TestAmerica Westfield Certifications and Approvals: MADEP MA014, RIDOH57, CTDPH 0494, VT DECWSD, NH DES 253903-A, NELAP FL E87912 TOX, NELAP NJ MA008 TOX, NELAP NY 10843, NY DOH 10843.

TestAmerica Laboratories, Inc.
TestAmerica Westfield Westfield Executive Park, 53 Southampton Road, Westfield, MA 01085
Tel (413) 572-4000 Fax (413) 572-3707 www.testamericainc.com

ACCREDITED IN ACCORDANCE WITH nelac

METHOD SUMMARY

Client: Tighe & Bond

Job Number: 360-17421-1

Description	Lab Location	Method	Preparation Method
Matrix: Solid			
Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)	TAL WFD	SW846 7471A	
Mercury in Solid or Semi-Solid Waste (Manual Cold	TAL WFD		SW846 7471A

Lab References:

TAL WFD = TestAmerica Westfield

Method References:

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

METHOD / ANALYST SUMMARY

Client: Tighe & Bond

Job Number: 360-17421-1

Method	Analyst	Analyst ID
SW846 7471A	Balicki, Charles W	CWB
EPA PercentMoisture	Nasiatka, Ellen M	EMN

SAMPLE SUMMARY

Client: Tighe & Bond

Job Number: 360-17421-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
360-17421-1	Sed-1	Sediment	06/30/2008 1445	06/30/2008 1600

Jeffery Thelen
Tighe & Bond
53 Southampton Road
Westfield, MA 01085

Job Number: 360-17421-1

Client Sample ID: Sed-1
Lab Sample ID: 360-17421-1

Date Sampled: 06/30/2008 1445
Date Received: 06/30/2008 1600
Client Matrix: Sediment
Percent Solids: 37

Analyte	Result/Qualifier	Unit	MDL	RL	Dilution
Method: 7471A		Date Analyzed:	07/03/2008 0959		
Prep Method: 7471A		Date Prepared:	07/02/2008 1048		
Mercury	ND	mg/Kg	0.10	0.22	1.0

Login Sample Receipt Check List

Client: Tighe & Bond

Job Number: 360-17421-1

Login Number: 17421
Creator: Rinard, Kimberley A
List Number: 1

List Source: TestAmerica Westfield

Question	T / F/ NA	Comment
Radioactivity either was not measured or, if measured, is at or below background	N/A	
The cooler's custody seal, if present, is intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	4.3 C
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	N/A	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	

SAMPLE COLLECTION DATA: SOILS AND SOLIDS

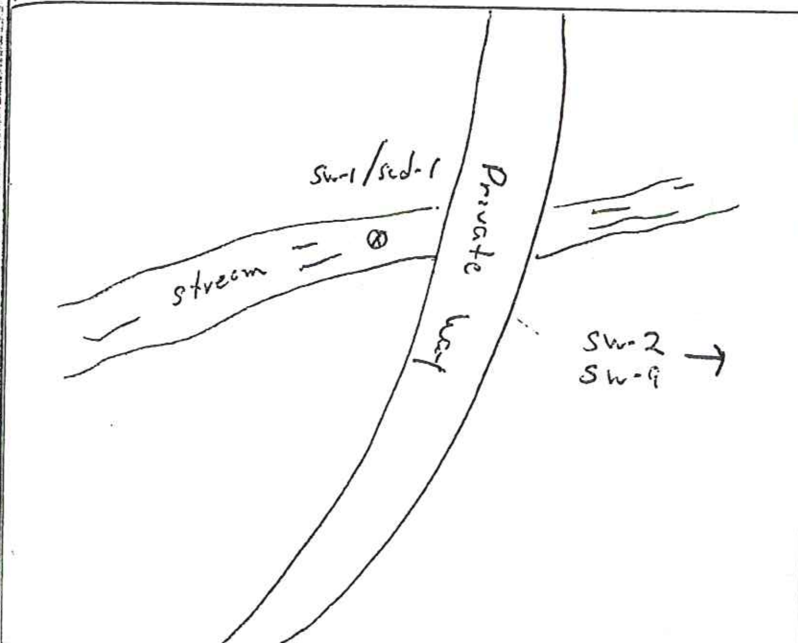
Client: Tighe & Bond
Westfield, MA
Contact: JST

Job #/ Project Manager: A308
Collector Signature: [signature]
Location: Sed-1

Date: 6/30/08 Time: 1445 Weather: Sunny 80's F

Site Descrip.:

MAP



COMMENTS

* Sample taken from staked location for sw-1/sed-1
* Sample is resample for Hg only.

Collection Method

Equipment: Hand Auger ____ Plastic Scoop ____ Stan Steel Scoop ✓
Coliwasa ____ Thief ____ Other ____

Equipment Decontamination: Organics ____ Metals_____ Biological ____

Sampl Type: ___Composite
_✓_Grab

Depth (s)

Sample Container	Analysis Requested
1- 8oz Amber glass jar	T. Hg

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Chain of Custody Form

1853

•53 Southampton Road
Westfield, MA 01085
(P) 413-572-4000
(F) 413-572-3707
Westfield

•148 Rangeway Road
N. Billerica, MA 01862
(P) 978-667-1400
(F) 978-667-7871
Boston - Service Center

Client: Tighe + Bond
Address: 53 Southampton Rd
Westfield, Ma
Phone: 413-562-1600 Fax:

Client Project #: A-0308
Site ID & State: Amherst, Ma
Reports Sent To: Jeff Thelen
Email: JThelen@tighebond.com Email Rpt: ☐

Job# 360-17421 Quote# PO#

Shaded areas for office use

Invoice same as Report to? ☐

If Invoice contact or address different, note in Comments

Comments (Special Instructions)

Please print legibly. If the analytical requests are not clearly defined on the chain-of-custody, the turnaround time will begin after all questions have been satisfactorily answered.

Requested Turnaround Time (PLEASE SPECIFY)
STANDARD ________ RUSH ________ (Lab Approval Required)

Regulatory Programs/Presumptive Certainty/QC Forms
MADEP MCP ☐ GW1/S1 ☐ PWS DEP Forms ☐
CTDEP RCP ☐ CT RSR ☐ EDD Required ☐
QA Rpt: No QC ☐ Std QC Rpt ☐ CLP ☐

500-series for drinking water
600-series for waste water, NPDES
6000-series for groundwater, soil, waste
8000-series for groundwater, soil, waste
Use comments section to further define.

Sample Type Codes: WW-Wastewater, DW-Drinking Water, SW-Surface Water, GW-Groundwater, LW Lab Water, A-Air, S-Solids, "Z"- Other (please specify)

Sample I.D.	Sample Type	Sampler's Initials	Date Time Collected	Grab	Comp.	# Containers	Plastic(P) or Glass(G)	NaHSO4/MeOH	HNO3 to pH <2	H2SO4 to pH <2	HCl to pH <2	NaOH to pH >12	Na2S2O3	None / 4º C	524 / 624 / 8260	525 / 625 / 8270	PCB / Pest / Herbicide	EPH / VPH	DRO / GRO / ETPH	Metals (Please Specify)	Mercury	General Chemistry	Bacteriological	Toxicity
Sed-1	Sed	AM	6/30/08 1445	✓		1	G							X						1.				

Comments:
1. T. Hg

Page 8 of 8

Sampled by (print): Adam Marchell Signature:

Relinquished by:	Date:	Time:	Received by:	Date:	Time:
[signature]	6/30/08		[signature]	6/30/08	1600

Cooler? (Y) / N
MADEP Requirement Samples Iced? (Y) / N
Temp @ receipt: 4.3°C ºC
Preservation / pH checked? Y / (N)
By: [initials] Date: 6/30/08

WESTFIELD

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White = Lab file Yellow = Report copy Pink = Customer copy

WI-QA-010-REV 4A

TAL-8245-360 (0408)

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

Job Number: 360-20692-1

Job Description: A-308

For:
Tighe & Bond
53 Southampton Road
Westfield, MA 01085

Attention: Jeffery Thelen

Joseph A. Chimi Jr.

Approved for release.
Joe Chimi
Report Production Representative
1/21/09 12:43 PM

Designee for
Lisa A Worthington
Project Manager II
lisa.worthington@testamericainc.com
01/21/2009

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Field sampling is performed under SOPs WE-FLD-001 and WE-FLD-002.

TestAmerica Laboratories, Inc.
TestAmerica Westfield Westfield Executive Park, 53 Southampton Road, Westfield, MA 01085
Tel (413) 572-4000 Fax (413) 572-3707 www.testamericainc.com

ACCREDITED IN ACCORDANCE WITH nelac

METHOD SUMMARY

Client: Tighe & Bond

Job Number: 360-20692-1

Description	Lab Location	Method	Preparation Method
Matrix: Solid			
Cyanide, Physiologically Available	TAL WFD	MA DEP 9012	
Cyanide, Physiologically Available - Distillation	TAL WFD		MA DEP PAC
Cyanide, Total and/or Amenable	TAL WFD	SW846 9012A	
Cyanide, Total and/or Amenable, Distillation	TAL WFD		SW846 9012A

Lab References:

TAL WFD = TestAmerica Westfield

Method References:

MA DEP = Massachusetts Department Of Environmental Protection

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

METHOD / ANALYST SUMMARY

Client: Tighe & Bond

Job Number: 360-20692-1

Method	Analyst	Analyst ID
MA DEP 9012	Lalashius, Andrew L	ALL
SW846 9012A	Lalashius, Andrew L	ALL
EPA PercentMoisture	Burton, Teresa F	TFB

SAMPLE SUMMARY

Client: Tighe & Bond

Job Number: 360-20692-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
360-20692-1	Sed-15A	Solid	01/08/2009 1220	01/08/2009 1425

Jeffery Thelen
Tighe & Bond
53 Southampton Road
Westfield, MA 01085

Job Number: 360-20692-1

Client Sample ID: Sed-15A
Lab Sample ID: 360-20692-1

Date Sampled: 01/08/2009 1220
Date Received: 01/08/2009 1425
Client Matrix: Solid
Percent Solids: 16

Analyte	Result/Qualifier	Unit	RL	RL	Dilution
Method: 9012		Date Analyzed:		01/20/2009 1328	
Prep Method: PAC		Date Prepared:		01/20/2009 1128	
Physiologically Available Cyanide	ND	mg/Kg	5.8	5.8	1.0
Method: 9012A		Date Analyzed:		01/19/2009 1438	
Prep Method: 9012A		Date Prepared:		01/19/2009 0935	
Cyanide, Total	ND	mg/Kg	5.7	5.7	1.0

Login Sample Receipt Check List

Client: Tighe & Bond

Job Number: 360-20692-1

List Source: TestAmerica Westfield

Login Number: 20692
Creator: Rinard, Kimberley A
List Number: 1

Question	T / F/ NA	Comment
Radioactivity either was not measured or, if measured, is at or below background	N/A	
The cooler's custody seal, if present, is intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	5.0 C
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	N/A	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	

SAMPLE COLLECTION DATA: SOILS AND SOLIDS

Client: Tighe Bond
Westfield, Ma

Job #/ Project Manager: A-308

Collector Signature: [signature]

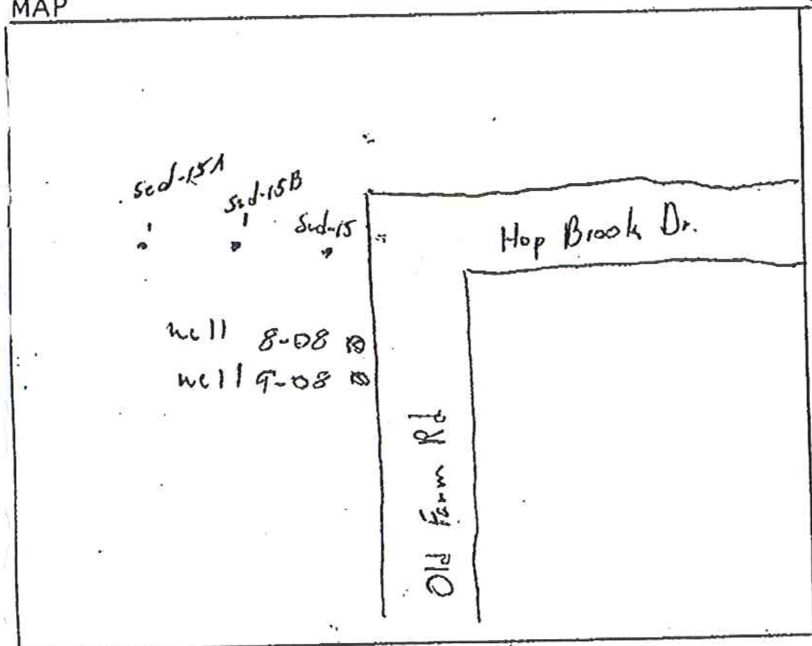
Contact: JJT

Location: Old Amherst LF

Date: 1/8/09 Time: 1220 Weather: Sunny 30's F

Site Descrip.:

MAP



COMMENTS

Collection Method

Equipment: Hand Auger ____ Plastic Scoop ____ Stan Steel Scoop ✓
Coliwasa ____ Thief ____ Other ____

Equipment Decontamination: Organics ✓ Metals ____ Biological ____

Sampl Type: ____ Composite
✓ Grab

Depth (s) 5-6"

Sample Container

4-oz amber jar

Analysis Requested

Total + Physiologically Available cyanide

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Chain of Custody Form

003744

•53 Southampton Road, Westfield, MA 01085, (P) 413-572-4000, (F) 413-572-3707, Westfield
•148 Rangeway Road, N. Billerica, MA 01862, (P) 978-667-1400, (F) 978-667-7871, Boston - Service Center

Client: Tighe & Bond
Address: 53 Southampton Rd, Westfield, MA 01085
Phone: 413-562-1600 Fax:

Client Project #: A-308
Site ID & State: Old Amherst LF
Reports Sent To: Jeff Thelen
Email: Email Rpt: ☐

Job# 360-20692 Quote# PO#

Shaded areas for office use

Invoice same as Report to? ☐
If Invoice contact or address different, note in Comments

Comments (Special Instructions)

Requested Turnaround Time (PLEASE SPECIFY)
STANDARD ______ RUSH ______ (Lab Approval Required)

Regulatory Programs/Presumptive Certainty/QC Forms
MADEP MCP ☐ GW1/S1 ☐ PWS DEP Forms ☐
CTDEP RCP ☐ CT RSR ☐ EDD Required ☐
QA Rpt: No QC ☐ Std QC Rpt ☐ CLP ☐

500-series for drinking water
600-series for waste water, NPDES
6000-series for groundwater, soil, waste
8000-series for groundwater, soil, waste
Use comments section to further define.

Please print legibly. If the analytical requests are not clearly defined on the chain-of-custody, the turnaround time will begin after all questions have been satisfactorily answered.

Sample Type Codes: WW-Wastewater, DW-Drinking Water, SW-Surface Water, GW-Groundwater, LW Lab Water, A-Air, S-Solids, "Z"- Other (please specify)

Sample I.D.	Sample Type	Sampler's Initials	Date / Time Collected	Grab	Comp.	# Containers	Plastic(P) or Glass(G)	NaHSO4/MeOH	HNO3 to pH <2	H2SO4 to pH <2	HCl to pH <2	NaOH to pH >12	Na2S2O3	None / 4º C	524 / 624 / 8260	525 / 625 / 8270	PCB / Pest / Herbicide	EPH / VPH	DRO / GRO / ETPH	Metals (Please Specify)	Mercury	General Chemistry	Bacteriological	Toxicity
Sed-15A	S	AM	1/8/09 1220	X		1	G							X								1		

Comments:
1. Total cyanide + PAC

Sampled by (print): Adam Marshall
Signature: [signature]

Relinquished by:	Date:	Time:	Received by:	Date:	Time:
[signature]	1/8/09	1425	[signature]	1/8/09	1425

Cooler? Ⓨ / N
MADEP Requirement: Samples Iced? Ⓨ / N
Temp @ receipt: 5.0°c ºC
Preservation / pH checked? Y / Ⓝ
By: Vm Date: 1/8/09

WESTFIELD

Page 1 of 1

White = Lab file Yellow = Report copy Pink = Customer copy

WI-QA-010-REV 4A TAL-8245-360 (0408)

Return Address:

TestAmerica Westfield
Westfield Executive Park
53 Southampton Road
Westfield, MA 01085

Ship To:

TIGHE & BOND
c/o: JEFFERY THELEN
53 SOUTHAMPTON ROAD
WESTFIELD, MA 01085

Job: 360-20692-1

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

Job Number: 360-20878-1

Job Description: A-0308

For:
Tighe & Bond
53 Southampton Road
Westfield, MA 01085

Attention: Jeffery Thelen

Joseph A. Chimi Jr.

Approved for release.
Joe Chimi
Report Production Representative
1/23/09 3:19 PM

Designee for
Lisa A Worthington
Project Manager II
lisa.worthington@testamericainc.com
01/23/2009

The test results in this report meet all NELAC requirements for accredited parameters. Any exceptions to NELAC requirements are noted in this report. Pursuant to NELAC, this report may not be reproduced except in full, and with written approval from the laboratory.

TestAmerica Westfield Certifications and Approvals: MADEP MA014, RIDOH57, CTDPH 0494, VT DECWSD, NH DES 2539, NELAP FL E87912 TOX, NELAP NJ MA008 TOX, NELAP NY 10843, NY DOH 10843.

Field sampling is performed under SOPs WE-FLD-001 and WE-FLD-002.

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METHOD SUMMARY

Client: Tighe & Bond

Job Number: 360-20878-1

Description	Lab Location	Method	Preparation Method
Matrix: Water			
Total Cyanide (Automated Colorimetric]	TAL WFD	SW846 9012A	
Cyanide, Total and/or Amenable, Distillation	TAL WFD		SW846 9012A

Lab References:

TAL WFD = TestAmerica Westfield

Method References:

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

METHOD / ANALYST SUMMARY

Client: Tighe & Bond

Job Number: 360-20878-1

Method	Analyst	Analyst ID
SW846 9012A	Lalashius, Andrew L	ALL

SAMPLE SUMMARY

Client: Tighe & Bond

Job Number: 360-20878-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
360-20878-1	SW-15A	Water	01/21/2009 1500	01/21/2009 1545

Jeffery Thelen
Tighe & Bond
53 Southampton Road
Westfield, MA 01085

Job Number: 360-20878-1

Client Sample ID: SW-15A
Lab Sample ID: 360-20878-1

Date Sampled: 01/21/2009 1500
Date Received: 01/21/2009 1545
Client Matrix: Water

Analyte	Result/Qualifier	Unit	RL	RL	Dilution
Method: 9012A		Date Analyzed:		01/23/2009 1246	
Prep Method: 9012A		Date Prepared:		01/23/2009 0950	
Cyanide, Total	ND	mg/L	0.0060	0.0060	1.0

Login Sample Receipt Check List

Client: Tighe & Bond

Job Number: 360-20878-1

Login Number: 20878
Creator: Tremblay, Kara R
List Number: 1

List Source: TestAmerica Westfield

Question	T / F/ NA	Comment
Radioactivity either was not measured or, if measured, is at or below background	N/A	
The cooler's custody seal, if present, is intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	1.0 C
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	N/A	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	

SAMPLE COLLECTION DATA SURFACE WATER

Client: TIGHE + BOND
53 SOUTHAMPTON ROAD
WESTFIELD MA

Job Number: A-0308-7-03
Sampling Location: SW-15A

Contact: JJT

Collected By: CM Date: 1/21/09 Time Collected: 1500

Weather: Sunny 20°F

Sampling Method:

Surface: X Bottle: X
Stainless Steel Bucket: Other:

Sample Type: Grab: X Composite: ______ if so describe

FIELD DATA

pH	Dissolved Oxygen mg/L	Specific Conductance µmhos/cm @25°C	Temperature °C	Residual Chloride mg/L	—	Time Analyzed
—	—	—	—	—	—	—

CONTAINERS & PRESERVATIVES

Type of Container	Number of Containers	Preservative Type/Amount	Analysis Required	Field pH
250mL pL	1	NaOH	T. CN	>12

If sample was taken for dissolved metals, were these samples field filtered? N/A

Date: — Time: — By: — Filter Pore Size & Type: —

General Notes:

Field Charges

Time: Gas Meter Rental:
Mileage: Other:
pH Meter Rental: Signature: Date:
DO Meter Rental:

TestAmerica Laboratories, Inc.
Chain of Custody Form

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Westfield, MA 01085
(P) 413-572-4000
(F) 413-572-3707

•148 Rangeway Road
N. Billerica, MA 01862
(P) 978-667-1400
(F) 978-667-7871

Client: Tighe &Bond
Address: 53 Southampton Rd.
Westfield, MA 01085
Phone: 413-562-1600 Fax:

Job#: A 0308-7-03
Project Manager:
Work ID: Old Amherst LF
Contact: Jeff Thelen

Requested Turn Around Time
15 Business Day ____ Rush ____
10 Business Day ____ Other ____

NPDES ____ Drinking Water ____ MCP Other ____
RCRA ____ MCP GW1 ____ Other ____

Job#: Quote#: PO#:
Shaded areas for office use

Analysis Requested
Check analysis and specify method and analytes in comments section.
For example:
500-series for drinking water
600-series for waste water
8000-series for haz/solid waste
Use comments section to further define.

Comments
(Special Instructions)
1. CN
~~2. Diss. Pb~~

Sample Type Codes
WW-Wellwater W-Wastewater SW-Surfacewater LW-Labwater
RW-Raw Water GW-Groundwater PW-Public Water SO-Soil
S-Solid SL-Sludge O-Oil A-Air Z-Other

Sample ID	Sample Type	Sampler's Initials	Date Time Collected	Grab	Comp.	# Containers	Plastic(P) or Glass(G)	NaHSO4/MeOH	HNO3 to pH <2	H2SO4 to pH <2	HCl to pH <2	NaOH to pH >2	Other	4° C	pH	Volatiles	Semivolatiles	PCB & Pesticides	EPH	VPH	DRO/GRO (circle)	Oil & Grease	Metals	General Chemistry	Bacteriological	Other
SW-15A	SW	CM	1/21/09 1500	X								X												1		
	~~SW~~			~~X~~					~~X~~														~~2~~			

EFT 1/21/09

Page 8 of 8

Sampled by (print): CHARLIE MOON
Signature: Charlie Moon
Relinquished by: Charlie Moon Date: 1/21/09 Time: 1545
Received by: Kara Tremblay Date: 1/21/09 Time: 1545
Relinquished by: Date: Time:
Received by: Date: Time:
Method of shipment: TestAmerica Laboratories

Cooler #: Temp @ receipt: Preservation (pH) checked: By: Date:

Q:/qaqc/dcontrol/SMF00500.MA

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

Job Number: 360-20878-2

Job Description: A-0308

For:
Tighe & Bond
53 Southampton Road
Westfield, MA 01085

Attention: Jeffery Thelen

Joseph A. Chimi Jr.

Approved for release.
Joe Chimi
Report Production Representative
1/26/09 12:09 PM

Designee for
Lisa A Worthington
Project Manager II
lisa.worthington@testamericainc.com
01/26/2009

The test results in this report meet all NELAC requirements for accredited parameters. Any exceptions to NELAC requirements are noted in this report. Pursuant to NELAC, this report may not be reproduced except in full, and with written approval from the laboratory.

TestAmerica Westfield Certifications and Approvals: MADEP MA014, RIDOH57, CTDPH 0494, VT DECWSD, NH DES 2539, NELAP FL E87912 TOX, NELAP NJ MA008 TOX, NELAP NY 10843, NY DOH 10843.

Field sampling is performed under SOPs WE-FLD-001 and WE-FLD-002.

METHOD SUMMARY

Client: Tighe & Bond

Job Number: 360-20878-2

Description	Lab Location	Method	Preparation Method
Matrix: Water			
Cyanide, Physiologically Available	TAL WFD	MA DEP 9012	
Cyanide, Physiologically Available - Distillation	TAL WFD		MA DEP PAC

Lab References:

TAL WFD = TestAmerica Westfield

Method References:

MA DEP = Massachusetts Department Of Environmental Protection

METHOD / ANALYST SUMMARY

Client: Tighe & Bond

Job Number: 360-20878-2

Method	Analyst	Analyst ID
MA DEP 9012	Lalashius, Andrew L	ALL

SAMPLE SUMMARY

Client: Tighe & Bond

Job Number: 360-20878-2

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
360-20878-1	SW-15A	Water	01/21/2009 1500	01/21/2009 1545

Jeffery Thelen
Tighe & Bond
53 Southampton Road
Westfield, MA 01085

Job Number: 360-20878-2

Client Sample ID: SW-15A
Lab Sample ID: 360-20878-1

Date Sampled: 01/21/2009 1500
Date Received: 01/21/2009 1545
Client Matrix: Water

Analyte	Result/Qualifier	Unit	RL	RL	Dilution
Method: 9012		Date Analyzed:	01/26/2009 1144		
Prep Method: PAC		Date Prepared:	01/26/2009 0950		
Physiologically Available Cyanide	ND	mg/L	0.0060	0.0060	1.0

Login Sample Receipt Check List

Client: Tighe & Bond

Job Number: 360-20878-2

Login Number: 20878
Creator: Tremblay, Kara R
List Number: 1

List Source: TestAmerica Westfield

Question	T / F/ NA	Comment
Radioactivity either was not measured or, if measured, is at or below background	N/A	
The cooler's custody seal, if present, is intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	1.0 C
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	N/A	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	

SAMPLE COLLECTION DATA SURFACE WATER

Client: TIGHE + BOND
53 SOUTHAMPTON ROAD
WESTFIELD MA

Job Number: A-0308-7-03
Sampling Location: SW-15A

Contact: JJT
Collected By: CM
Date: 1/21/09
Time Collected: 1500

Weather: SUNNY 20°F

Sampling Method:

Surface: X
Stainless Steel Bucket:
Bottle: X
Other:

Sample Type: Grab: X
Composite: ______ if so describe

FIELD DATA

pH	Dissolved Oxygen mg/L	Specific Conductance µmhos/cm @25°C	Temperature °C	Residual Chloride mg/L	—	Time Analyzed
—	—	—	—	—	—	—

CONTAINERS & PRESERVATIVES

Type of Container	Number of Containers	Preservative Type/Amount	Analysis Required	Field pH
250mL pL	1	NaOH	T.CN	>12

If sample was taken for dissolved metals, were these samples field filtered? N/A

Date: — Time: — By: — Filter Pore Size & Type: —

General Notes:

Field Charges

Time:
Gas Meter Rental:
Mileage:
Other:
pH Meter Rental:
Signature:
Date:
DO Meter Rental:

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Chain of Custody Form

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(F) 413-572-3707

•148 Rangeway Road
N. Billerica, MA 01862
(P) 978-667-1400
(F) 978-667-7871

Client: Tighe &Bond
Address: 53 Southampton Rd.
Westfield, MA 01085
Phone: 413-562-1600 Fax:

Job#: A 0308-7-03
Project Manager:
Work ID: Old Amherst LF
Contact: Jeff Thelen

Requested Turn Around Time
15 Business Day ______ Rush ______
10 Business Day ______ Other ______

NPDES ______ Drinking Water ______ MCP Other ______
RCRA ______ MCP GW1 ______ Other ______

Sample Type Codes
WW-Wellwater W-Wastewater SW-Surfacewater LW-Labwater
RW-Raw Water GW-Groundwater PW-Public Water SO-Soil
S-Solid SL-Sludge O-Oil A-Air Z-Other

Shaded areas for office use

Analysis Requested
Check analysis and specify method and analytes in comments section.
For example:
500-series for drinking water
600-series for waste water
8000-series for haz/solid waste
Use comments section to further define.

Comments
(Special Instructions)
1. CN
~~2. Diss. Pb~~

Sample ID	Sample Type	Sampler's Initials	Date Time Collected	Grab	Comp.	# Containers	Plastic(P) or Glass(G)	Preservative: NaHSO4/MeOH	HNO3 to pH <2	H2SO4 to pH <2	HCl to pH <2	NaOH to pH >2	Other:	4° C	Volatiles	Semivolatiles	PCB & Pesticides	EPH	VPH	DRO/GRO (circle)	Oil & Grease	Metals	General Chemistry	Bacteriological	Other
SW-15A	SW	CM	1/21/09 1500	X								X											1		
	~~SW~~			~~X~~					~~X~~													~~2~~			

KT 1/21/09

Sampled by (print): CHARLIE MOON
Signature: Charlie Moon

Relinquished by: Charlie Moon Date: 1/21/09 Time: 1545
Received by: Kara Tremblay Date: 1/21/09 Time: 1545

Relinquished by: Date: Time:
Received by: Date: Time:

Method of shipment: TestAmerica Laboratories

Q:/qaqc/dcontrol/SMF00500.MA

KERA
ENVIRONMENTAL

FOCUSED RISK CHARACTERIZATION
(in accordance with 310 CMR 40.0900)

for

MADEP-Specified Sediments
Old Amherst Landfill
(SLF#008.001)
Route 9
Amherst, MA

January 27, 2009

Prepared for

Tighe & Bond, Inc.
Westfield, MA

Prepared by

KERA Environmental, LLC
Worthington, MA

4 S. Worthington Road, Suite A, Worthington, MA 01098-9515
Tel: 413-238-0200 Fax: 413-238-0202 Email: kewald@rcn.com

EXECUTIVE SUMMARY

In accordance with the Massachusetts Department of Environmental Protection (MADEP) letter to the Town of Amherst Department of Public Works (dated December 29, 2008)[1], KERA Environmental, LLC has prepared a focused site-specific risk assessment for potential human exposure to select areas of sediment west and northwest of the Old Amherst Landfill (Site ID: SLF#008-001), Amherst, MA (landfill). Although the landfill and surrounding wetlands are not listed as a Massachusetts Contingency Plan (MCP)[2] site, this focused risk characterization was conducted in compliance with MCP Method 3 Risk Characterization (310 CMR 40.0900) as it applies to landfills (310 CMR 40.0114) protocol, and also in accordance with the Landfill Technical Guidance Manual (LAC), Chapter 8, Section V, 1997. Current and future risk of harm to safety, public welfare and the environment were not within the scope of this risk characterization.

Sediment data, site plans and other information included in the Final Comprehensive Site Assessment report (FCSA)[3] were provided by Tighe & Bond, Inc., Westfield, MA on behalf of the Town of Amherst Department of Public Works for review in preparation of the risk characterization. Analytical data indicate that elevated concentrations of arsenic (As) and cadmium (Cd) are distributed in wetland sediments between Hop Brook Drive and Old Farm Road (SED-6 and SED-6 series, SED-14 and SED-16), and in sediments at the inlet of Gull Pond (SED-1 series). An elevated boardwalk transects the southeastern portion of the wetland between Hop Brook Drive and Old Farm Road, from north, northeast to southwest. Both wetlands and pond sediments are readily accessible to the surrounding residential community. Analytical data used in this risk characterization is summarized in Table A-1, Attachment A, of this report. Sample locations are identified on the FCSA Site Plans provided in the FCSA.

Following a detailed exposure assessment, risks were quantitatively evaluated for two groups of children: a fall victim (5<12 years old); and a neighborhood child (11<18 years old). These children are assumed to experience contact with As and Cd in sediment through ingestion and dermal contact. Exposure Point Concentrations (EPCs) reflect the maximum average As and Cd concentrations selected from the wetland, wetland-perimeter, wetland-boardwalk and inlet to Gull Pond areas.

Conclusions

Cumulative cancer and non-cancer risks for each receptor were calculated as part of this risk assessment and are expressed as Excess Lifetime Cancer Risk (ELCR) and Hazard Index (HI) values, respectively. The ELCR and HI values were then compared to the applicable MADEP risk criteria (1.0E-05 and 1, respectively) to evaluate risk posed by As and Cd in selected area sediments. The comparisons indicate that a condition of No Significant Risk to human health is demonstrated for the fall victim and the neighborhood child scenarios and, by inference, for any scenarios with lesser frequency and duration exposures. Quantitative results indicating No Significant Risk are provided below:

	HI	HI > 1?	ELCR	ELCR > 1E-05?
Fall Victim (5<12 yr)	0.0078	NO	1.8E-07	NO
Neighborhood Child (11<18 yr)	0.24	NO	4.9E-06	NO

Results of this risk characterization assume that all receptors have been accounted for, that the landfill and surrounding environmental media have been effectively delineated, and that data used to support the risk characterization is representative of current and future conditions in the selected area sediments. Current and future risk of harm to safety, public welfare and the environment were not within the scope of this risk characterization.

ATTACHMENTS

1.0 INTRODUCTION

1.1 General

KERA Environmental, LLC, Worthington, MA (KERA) has prepared a focused site-specific risk assessment for potential human exposure to select areas of sediment west and northwest of the Old Amherst Landfill (Site ID: SLF#008-001), Amherst, MA (landfill). Although the landfill and surrounding wetlands is not a listed Massachusetts Contingency Plan (MCP) site, this focused risk characterization was conducted in compliance with MCP Method 3 Risk Characterization (310 CMR 40.0900 and 310 CMR 40.0114) protocol, and also in accordance with the Landfill Technical Guidance Manual (LAC), Chapter 8, Section V, 1997. Current and future risk of harm to safety, public welfare and the environment were not within the scope of this risk characterization.

Sediment data, site plans and other information included in the FCSA Report were provided by Tighe & Bond, Inc., Westfield, MA on behalf of the Town of Amherst Department of Public Works for review in preparation of the risk characterization. Materials indicate that elevated concentrations of arsenic (As) and cadmium (Cd) are distributed in wetland sediments between Hop Brook Drive and Old Farm Road (SED-6 and SED-6 series, SED-14 and SED-16), and in sediments at the inlet of Gull Pond (SED-1 series). An elevated boardwalk transects the southeastern portion of the wetland between Hop Brook Drive and Old Farm Road, from north, northeast to southwest. Both wetlands and pond sediments are readily accessible to the surrounding residential community. Analytical data used in this risk characterization is summarized in Table A-1, Attachment A, of this report. Sample locations are identified on the FCSA Site Plans.

According to the MADEP letter dated December 29, 2008, a focused quantitative risk characterization was requested to evaluate potential human health risk from elevated levels of certain As in sediment in the "…visibly-impacted ponded area located just south of Cross Brook Lane, which discharges to Gull Pond, at sediment locations SED-1 to SED-1C…" A potential human health risk evaluation for elevated levels of As and Cd was also requested for the "…visibly-impacted wetland area west/northwest of the KC Trail, at sediment locations SED-6 to SED-6L, SED-14 & SED-16…" Specific exposure scenarios of concern were not provided.

1.2 Risk Characterization Method Summary

Method 3 risk characterization is a site-specific approach, which provides an opportunity to incorporate site-specific conditions into the risk calculations. The evaluation takes into account the types of compounds, their concentrations and the site-specific exposure pathways linking receptors (fall victims and neighborhood children) to impacted media (sediment). Cancer and non-cancer risk of harm to human health are quantified and expressed as ELCR and HI values, respectively. These values are compared to cancer and non-cancer risk criteria (ELCR = 1E-05 and HI = 1). Risks of harm to the public welfare, safety and the environment are not within the scope of this focused risk characterization.

2.0 SITE CHARACTERIZATION

As per MCP 310 CMR 40.0904, an adequate characterization of the site is required to support a risk characterization.

2.1 Physical Characteristics

The wetland area between Hop Brook Drive and Old Farm Road (approximately 2 acres; SED-6 and SED-6 series, SED-14 and SED-16) is located about 2000 feet due west of the Old Amherst Landfill. The inlet of Gull Pond (approximately 30 x 60 feet; SED-1 series) is located about 1700 feet northwest of the landfill. Groundwater flows in a westerly direction across the landfill and toward the wetland and Gull Pond areas. An elevated boardwalk (part of the Ken Cuddeback (KC) Trail system) transects the southeastern portion of the wetland between Hop Brook Drive and Old Farm Road, from north/northeast to southwest. Both the KC Trail wetland area and the Gull Pond inlet area abut residential properties.

2.2 Release and Investigation History

The landfill was reported to have been in use until 1982. In accordance with the Massachusetts Solid Waste landfill regulations (310 CMR 19.150) an assessment monitoring program included sediment sample collection and analysis for the subject wetland and inlet-to-Gull-Pond areas. Although sediments have been analyzed for a variety of landfill parameters throughout this time, the MADEP has specified As and Cd for consideration in the requested risk evaluation.

Arsenic and cadmium were detected in surficial (0 to 6 inches below grade) sediment samples collected from the wetland area in November 2005, May and October of 2008. Arsenic concentrations were detected in 16 of 16 samples and range from 1.6 mg/kg to 260 mg/kg. Cadmium concentrations, detected in 15 of 16 samples, range for 0.5 mg/kg to 11 mg/kg. MADEP only specified consideration of As in the Gull Pond inlet sediments. Arsenic concentrations, detected in 6 of the 6 sediment samples collected from this area, ranged from 18 mg/kg to 130 mg/kg.

See Section 5 of the FCSA Report for a detailed discussion of the environmental investigation history. Sample locations are identified on site plans in the same report.

2.3 Current and Foreseeable Future Uses

As described in Section 2.1, the wetland area is within the boundaries of conservation land that includes the KC Trail system. An elevated boardwalk passes over the subject wetland sediments. Although the Gull Pond inlet is not developed for recreational use, there are no notable barriers to access in this area. Consideration of other potential future uses of these subject areas was not requested by the MADEP.

2.4 Soil and Groundwater Classification

Categorization of soil and groundwater as specified in the MCP usually is conducted to identify the Method 1 standards applicable to the site. However, these categorizations also are useful for a Method 3 assessment (310 CMR 40.0930) by providing an indication of the types of exposures that may be associated with the site.

The MCP defines three categories of groundwater (310 CMR 40.0932), classified according to the following potential exposures:

- GW-1: groundwater that includes potential or current sources of drinking water (310 CMR 40.0932(4)).
- GW-2: groundwater that is considered to be a source of oil or hazardous material (OHM) vapor migration to indoor air. It is limited to groundwater where the average annual depth of the water table is less than 15 feet from the ground surface and within 30 feet of an occupied building.
- GW-3: groundwater at all disposal sites based on the potential for discharge to surface water.

Although groundwater in the subject areas would be classified as GW-3 according to the above criteria, evaluation of groundwater exposures is not within the scope of this focused risk characterization.

The MCP also defines three soil classifications for use in risk characterizations (310 CMR 40.0933). However, soil is not a noted media of concern for this evaluation. For comparison purposes only, a high intensity, low frequency exposure was assumed for children in the vicinity of the subject surficial sediments.

3.0 HAZARD IDENTIFICATION

This section presents the rationale to support the selection of site compounds of concern (COCs) and corresponding EPCs to be carried through the risk characterization.

3.1 Summary Site Compound Characteristics

For the purpose of this focused risk characterization, sediment quality in the wetland area is characterized by detectable concentrations of As and Cd. The Gull Pond inlet sediments are characterized by As, only.

Analytical data used in this risk characterization are summarized in Table A-1, Attachment A of this report. A complete set of sediment data is available in Section 5 of the FCSA Report.

3.2 Selection of Compounds of Potential Concern

In accordance with MADEP letter dated December 29, 2008, As and Cd in the subject sediments are the compounds of potential concern (COPC) and thus carried through this focused risk assessment. See Attachment A, Tables A-1 for the lists of sediment COPCs.

3.3 Criteria for Eliminating a Compound from the List of COPCs

Some of the COPCs may not reflect true site-specific conditions and thus may be eliminated based on the following considerations:

- Compound is detected at low frequency, low concentration, <u>and</u> has no history of use at the site; and
- Any compound that is detected in both sample and quality control blanks that is evaluated and determined to be attributable to laboratory contamination.

Both As and Cd have a potential history associated with the landfill. For the purpose of this risk characterization, no sediment COPCs were eliminated due to low frequency, low concentration or laboratory contamination.

3.4 Selection of Site Compounds of Concern

Compounds not eliminated from the list of COPCs by the screening criteria above are compared to background conditions to determine the final list of site COCs to be carried through the risk characterization.

The MCP (310 CMR 40.0902(3)) requires that site COPC concentrations be compared to background concentrations. According to the MADEP, background concentrations are those concentrations of oil and hazardous material that would exist in the absence of the disposal site, which are ubiquitous and attributable to geologic, ecologic and atmospheric conditions, or conditions unrelated to the site. Compounds that are detected below background are not carried through the risk assessment.

Massachusetts default background concentrations for sediment are not available, thus background concentrations for As and Cd were assumed to be non-detect. For comparison purposes only, the maximum detected sediment concentrations for As (260 mg/kg) and Cd (11 mg/kg) exceed MADEP background concentrations[4] for As in soil (20 mg/kg) and Cd in soil (2 mg/kg), suggesting that the detected sediment concentrations are not likely to exist in the absence of the landfill.

3.5 Soil Compounds of Concern and Exposure Point Concentrations

Soil was not identified as a media of concern in the MADEP letter dated December 29, 2008 therefore, no soil COCs or corresponding EPCs were carried through the risk characterization.

3.6 Groundwater Compounds of Concern and Exposure Point Concentrations

Groundwater was not identified as a media of concern in the MADEP letter dated December 29, 2008 therefore, no groundwater COCs or corresponding EPCs were carried through the risk characterization.

3.7 Sediment Compounds of Concern and Exposure Point Concentrations

Sediment quality in the subject KC Trail wetland and Gull Pond areas is characterized by elevated concentrations of As. Elevated Cd concentrations were also reported in subject KC Trail wetland sediment. Neither of these compounds was eliminated from the list of COPCs and thus both are carried through the risk characterization as COCs.

Four sets of COC average concentrations were considered in the derivation of EPCs for As and Cd: maximum average (based on wetland and inlet averages), wetlands-perimeter average and wetlands-boardwalk average. Average concentrations for As and Cd were calculated to characterize the wetland area (SED-6, SED-6 series, SED-14 and SED-16), and another average (As only) to characterize the inlet to Gull Pond (SED-1 and SED-1 series). The wetland-perimeter averages are based on the SED-6 series A through J and L. The wetland-boardwalk averages are based on samples collected at SED-6 in November 2005, May 2008 and October 2008. Note: The wetland perimeter was considered more accessible to neighborhood children and potential fall victims than the inner areas of the wetland and thus considered a possible separate point of exposure. The wetland-boardwalk in the vicinity of SED-6 was considered the worst case exposure point along the boardwalk.

site maximum concentrations for As and Cd (260 mg/kg and 11 mg/kg, respectively) were considered for use as possible worst-case EPCs. However, since these concentrations were detected in the middle of the 2-acre wetland area (SED-6K) and routine access is assumed to be highly unlikely, the use of these concentrations as EPCs was considered overly conservative and thus not of practical value in this focused risk characterization.

Average sediment concentrations used in deriving a maximum average concentration for As and Cd EPCs to be carried through the risk characterization are presented in Attachment A, Table A-3.

3.8 Comparison of Site EPCs to Suitably Analogous Standards or Guidelines

In accordance with MCP 310 CMR 40.0993(3) and (7)(a), site conditions must also comply with any applicable public health standards or guidelines, including Massachusetts Air Quality Standards, Massachusetts Drinking Water Quality Standards, Massachusetts Surface Water Quality Standards and National Ambient Water Quality Standards. A conclusion of No Significant Risk must satisfy the criteria that no EPC exceeds an applicable suitably analogous standard.

No suitably analogous standards or guidelines are currently available for sediments.

4.0 DOSE RESPONSE

Dose-response relates the amount of compound experienced by the receptor (person, animal) with a consequent adverse health effect. This relationship is characterized by a series of reference values derived from a thorough evaluation of scientifically defensible dose response studies. These reference values reflect the maximum compound level to which a receptor may be exposed with no significant adverse effect. While accounting for these non-cancer and carcinogenic effects, the values must be adjusted to reflect chemical bioavailability. To this end, a relative absorption factor (RAF) is applied. Non-cancer and cancer reference values and RAFs are discussed in greater detail in the following sections.

Available sources for reference values include the MADEP Background Document for Method 1 Standards[5] US Environmental Protection Agency's (EPA) Integrative Risk Information System (IRIS)[6], EPA Region III and IX Risk Based Concentrations[7,8] and/or current literature.

Chemical-specific cancer and non-cancer reference values and factors are provided in Attachment A, Table A-2 of this document.

4.1 Carcinogenic Effects

The EPA assumes a non-threshold (linear) response relationship between the quantity of carcinogen to which a receptor is exposed and the development of cancer. The guiding principle, therefore, is that no dose exists below which there is no risk of cancer. Carcinogenic effects are characterized by the cancer slope factor (CSF) for ingestion and dermal exposures. The EPA classifies chemical carcinogens according to a weight-of-evidence scheme: A -- human carcinogen; B1/B2 – probable human carcinogen; C – possible human carcinogen; D – not classified (inadequate data); and E -- no evidence of human carcinogenicity. Carcinogens classified under Group A, B1 and B2 are necessarily evaluated in this human health risk characterization.

4.2 Non-cancer Effects

Evaluation of non-cancer toxicity assumes that there is a dose, below which, no adverse effects are observed. The dose is known as the threshold dose. Based on this concept, dose response studies are designed to identify a no observable adverse effect level (NOAEL) or Benchmark Dose Lower Limit (BMDL). This dose level, adjusted to account for differences between study conditions and application conditions, is used to derive the reference dose and concentration values that characterize non-cancer effects. Ingestion and dermal exposures are evaluated using the reference dose (RfD).

4.3 Relative Absorption Factors (RAF)

The relationship between the amount of chemical and its ultimate effect depends on its capacity for absorption into the blood or tissue, i.e., its bioavailability. Bioavailability depends of the type of contaminated media and whether that media is ingested, contacted through dermal exposure, or inhaled. RAFs are chemical-specific factors used in exposure equations to adjust for bioavailability.

4.4 Toxicity Profiles

Summaries of the potential human-health hazards associated with COCs are documented in toxicity profiles. They include information about absorption, distribution and elimination of chemicals after exposure, and specific non-carcinogenic and carcinogenic effects of COCs. Toxicity profiles are provided in Attachment B of this document.

5.0 EXPOSURE ASSESSMENT

The Exposure assessment is based on assumptions derived from current and reasonably foreseeable future uses of the site (Section 2.3). These assumptions will serve to define the current and future exposure scenarios and many of the exposure assumptions.

5.1 Receptors

Receptors are those people (fall victims and neighborhood children) who are assumed to have contact with landfill-related As and Cd in subject area subject area sediments, currently or in the foreseeable future. They are characterized by age, weight and potential frequency, intensity and duration of contact with environmental media.

- Fall Victims, children, 5 to 12 years old, who weigh 28 kg and have a skin surface area of 3450 cm^2, living in homes located in the immediate vicinity of an area of subject sediment, who are assumed to have an accidental fall from the boardwalk 1 time per year for 7 years. This scenario also includes the subchronic receptor 5 to 6 years old, weighing 19 kg, with a skin surface area of 2779 cm^2, who may have an accidental fall from the boardwalk 1 time per year for 1 year.

- Neighborhood Children, children 11 to 18 years old, who weigh 50.7 kg and have a skin surface area of 2940 cm^2, and living in homes located in the immediate vicinity of an area of subject sediment, who are assumed to play around the areas of subject sediment 60 days a year for 7 years.

  Note: this scenario is conservatively based on the standard trespassers scenario and includes a non-cancer risk based on children 11 < 12 years old who have a surface area of 2477 cm^2 and a body weight of 40.3 kg.

5.2 Points of Exposure

Exposure points characterize the location where a receptor may encounter contaminated media. Based on consideration of current and future activities around the wetland and Gull Pond inlet, and guided by MADEP request, sediment in these two specified areas are considered exposure points for this risk characterization.

5.3 Routes of Exposure

The route of exposure describes how a compound passes from environmental media into the body. Routes of exposure assumed to be associated with sediment include ingestion and dermal contact.

5.4 Exposure Pathways

Exposure pathways trace exposure scenarios beginning with the source of site compounds, transport of compounds through all possible environmental media to specific exposure points, and ultimately, by each route of exposure, to contact with each receptor. The following table highlights the complete exposure pathways possibly associated with the subject areas of sediment.

Source	Migration	Exposure Point	Exposure Route	Receptor
Landfill Leachate	Groundwater	Sediment	Ingestion	Fall Victims
Landfill Leachate	Groundwater	Sediment	Dermal Contact	Fall Victims

Landfill Leachate	Groundwater	Sediment	Ingestion	Neighborhood Children
Landfill Leachate	Groundwater	Sediment	Dermal Contact	Neighborhood Children

5.5 Exposure Profile -- Current Uses

This exposure profile describes how current receptors at the site may be exposed to impacted media at the site. Fall victims are assumed to be children ages 5 to 12 years and neighborhood children are assumed to be 11 to 18 years old. Both receptor groups are assumed to be living in residential dwellings around the wetlands or around the inlet to Gull Pond, and have unobstructed access to subject area sediments. Contact is assumed to occur for children who might stumble and fall once during a year (or over 7 years during a lifetime) while playing along the boardwalk or around the inlet to Gull Pond (fall victims). Contact is also assumed to occur for children who routinely (2 days/week) play in and around the subject areas during the warmer months over seven years (neighborhood children).

It should be noted that although children may realistically be involved in activities around subject sediments for only a fraction of a 24-hour day, the studies used to evaluate soil ingestion and dermal exposures (applied here for sediment exposures) cannot be modified to accommodate a fraction of a day, thus the exposure is estimated to take place over a 24-hour day.

5.6 Exposure Profile -- Foreseeable Future Uses

For the purpose of this risk characterization, foreseeable future uses are consistent with current uses. Therefore, the exposure profile is the same as that described under Current Use, above.

5.7 Quantitative and Qualitative Evaluations

As is standard practice, in an effort to streamline the risk assessment process some exposure pathways may be evaluated qualitatively based on results for quantitatively evaluated scenarios, which are expected to reflect the most conservative exposures likely to occur under current and foreseeable future uses of a site. Although no scenarios were explicitly evaluated qualitatively, it is assumed that the results of this risk characterization will be sufficiently protective of less frequent and less intense exposures, including the potential vector scenario of a dog transporting sediment to a residence.

5.8 Exposure Equations

The exposure equations and related parameters used to determine average daily dose (ADD) and lifetime average daily dose (LADD) values representing exposure profiles discussed in Sections 5.5 and 5.6 were obtained from Section 7.0 of the *MADEP Guidance for Disposal Site*

Risk Characterization[9], MADEP Shortform for 2006[10], and MADEP Technical Updates for skin-soil adherence factors[11]. See Attachment A, Table A-2 for exposure equations.

6.0 HUMAN HEALTH RISK CHARACTERIZATION (310 CMR 40.0993)

Method 3 can be used to characterize human health risk at a site for all exposure pathways except where EPCs exceed applicable or suitably analogous public health standards (310 CMR 40.0993(3)). No suitably analogous standards apply to the site (see Section 3.8 of this report).

6.1 Cancer Risk Assessment

Cancer risk is characterized by ELCR, and is calculated by multiplying compound-specific LADD values by the chemical-specific CSF for oral and dermal exposures. Summing ELCR values across compound, route of exposure and impacted media derives a cumulative ELCR for each receptor.

Arsenic is the only COC that is carcinogenic by ingestion. Cumulative cancer risks associated with exposure to As in sediment was quantitatively evaluated for fall victims and neighborhood children.

6.2 Non-Cancer Risk Assessment

Subchronic and chronic non-cancer risks are characterized by the HI value, computed by dividing compound-specific ADD values by the chemical-specific subchronic or chronic RfDs for ingestion and dermal exposures. HIs are summed across compound, route of exposure and impacted media for each receptor, to derive cumulative subchronic and chronic non-cancer risks.

Both As and Cd are considered to have the potential for posing non-cancer risk. Cumulative non-cancer risks, therefore, were calculated for fall victims and neighborhood children who are assumed to come into contact with these COCs in subject area sediments.

6.3 Risk Equations

The risk equation for ELCR integrates exposure values with cancer reference values. ELCR is then used to characterize cancer risk for receptors who may experience contact with As and Cd while playing around the boardwalk or the Gull Pond inlet. Equations for determining the ELCR, as presented in the MADEP *Guidance for Disposal Site Risk Characterization*, are as follows:

$$ELCR_{compound} = LADD * CSF$$

$$ELCR_{route} = \Sigma ELCR_{compound}$$

$$ELCR_{cumulative} = \Sigma ELCR_{route}$$

The risk equation for HI integrates exposure values with non-cancer reference values. The HI is then used to characterize cancer risk for receptors who may experience contact with As and Cd while playing around the boardwalk or the Gull Pond inlet. HI equations, as presented in the MADEP *Guidance for Disposal Site Risk Characterization*, are as follows:

$$HI_{compound} = ADD/RfD$$
$$HI_{route} = \Sigma HI_{compound}$$
$$HI_{cumulative} = \Sigma HI_{route}$$

The summary cumulative HI and ELCR values for fall victims and neighborhood children are presented in Attachment A, Table A-3.

6.4 Conclusion of Human Health Risk Characterization

Cumulative ELCR and HI values (dimensionless) for each receptor are compared to risk criteria (dimensionless) to determine whether a condition of No Significant Risk (NSR) exists at the site. A condition of No Significant Risk exists at the site if both of the following statements are true:

> Cumulative HI is less than or equal to 1 for each receptor, and Cumulative ELCR is less than or equal to 1 in 100,000 (1E-05) for each receptor.

The cumulative ELCR values for fall victims and neighborhood children who may experience contact with As and Cd while playing around the boardwalk or the Gull Pond inlet are presented below. It should be noted that these risk results represent the worst-case among three sets of EPC averages carried through this risk characterization (i.e., EPCs based on maximum averages).

Risk Characterization		Risk Criteria	Status
$ELCR_{FallVictim}$	= 1.8 E - 07	1 E - 05	NSR
$ELCR_{NeighborhoodChildren}$	= 4.9 E - 06	1 E - 05	NSR

The cumulative HI values for fall victims and neighborhood children who may experience contact with As and Cd while playing around the boardwalk or the Gull Pond inlet are presented below. Again, it should be noted that these risk results represent the worst-case among three sets of EPC averages carried through this risk characterization (i.e., EPCs based on maximum averages).

Risk Characterization		Risk Criteria	Status
$HI_{FallVictim}$	= 0.0078	1	NSR
$HI_{NeighborhoodChildren}$	= 0.24	1	NSR

The calculated ELCR and HI values for fall victims and neighborhood children who may experience contact with As and Cd while playing around the boardwalk or the Gull Pond inlet are below the cancer and non-cancer risk criteria (ELCR = 1E-05 and HI = 1, respectively) indicating that As and Cd concentrations in subject sediments pose No Significant Risk to these receptors. Although no scenarios were explicitly evaluated qualitatively, it is assumed that the results of this risk characterization will be sufficiently protective of less frequent and less intense exposures, including the potential vector scenario of a dog transporting sediment to a residence.

7.0 RISK OF HARM TO SAFETY (310 CMR 40.0960)

Arsenic and cadmium in subject sediments is not expected to pose a physical-injury hazard (e.g., cuts, bruises, breaks, burns) thus the MADEP did not specify a MCP evaluation of risk of harm to safety in the letter dated December 29, 2008. An evaluation of risk of harm to safety, therefore, was not within the scope of this focused risk characterization

8.0 RISK OF HARM TO PUBLIC WELFARE (310 CMR 40.0994)

An MCP evaluation of risk of harm to public welfare was not specified in the MADEP letter dated December 29, 2008 since these considerations have been addressed under Solid Waste Regulations. Therefore, an evaluation of risk of harm to the public welfare was not within the scope of this focused risk characterization.

9.0 RISK OF HARM TO THE ENVIRONMENT (310 CMR 40.0995)

The MCP evaluation of risk to the environment was not requested in the MADEP letter (December 29, 2008) and thus not considered within the scope of this focused risk characterization.

10.0 UNCERTAINTY ANALYSIS

The inherent uncertainty in estimating non-cancer and cancer risk is characteristic of all risk assessments. Uncertainties arise from limitations in sampling methodology, sample analysis, exposure assumptions and available toxicity information. Conservative assumptions were made in this risk characterization to compensate for the effects of these uncertainties. Specific examples of the nature of these uncertainties are described in the following paragraphs.

Sample locations are selected to provide a representative characterization of site compounds. Data from these locations are, nevertheless, estimates, the nature of which may result in either an overestimation or underestimation of risk. Sampling methodology was designed to minimize these uncertainties. Sample locations were selected to identify areas of likely impact (in the vicinity of potential sources of oil and hazardous materials and areas of potential migration) and also based on the results from previous site investigations. This strategy would likely reflect areas of higher compound concentrations, contributing to the development of greater exposure point concentrations and thus may result in an overestimation of risk.

Sample compound concentrations are assumed to remain constant throughout the collection and handling process. Sampling, storage and handling strategies are designed to minimize volatilization, degradation and contamination of samples. Despite these efforts, varied chemical and physical conditions may introduce uncertainty into the ultimate risk characterization.

The exposure assessment portion of the risk characterization is by nature uncertain since it must be generalized for practical purposes. It does not account for the detailed variability among receptor characteristics, their behavior around exposure points and duration of exposure. Therefore, conservative exposure assumptions were used based on reasonable observation, experience and documentation. Also, as noted, soil ingestion and dermal exposures are estimated to take place over a 24-hour day. These assumptions provide a worst case scenario and thus may overestimate risk.

11.0 CONCLUSIONS

Results of this focused site-specific risk characterization indicate that a condition of No Significant Risk to human health exists for fall victims and neighborhood children (as defined) who engage in activities along the specified areas of the Ken Cuddeback Trail between Hop Brook Drive and Old Farm Road (SED-6 and SED-6 series, SED-14 and SED-16), and in the vicinity of the Gull Pond inlet (SED-1 series).

Cumulative cancer and non-cancer risks for each receptor were calculated as part of this risk assessment and are expressed as ELCR and HI values, respectively. These values were compared to the applicable DEP risk criteria (1.0E-05 and 1, respectively) to evaluate risk posed by the subject wetland and Gull Pond inlet sediments. The comparisons indicate that a condition of No Significant Risk to human health is demonstrated for the fall victim and the neighborhood children scenarios. Results are summarized in Table A-3, Attachment A of this report.

Results of this risk characterization assume that all receptors have been accounted for, that the area around the landfill has been effectively delineated, and that data used to support the risk characterization is representative of current and future conditions in subject sediments.

Evaluations of risk of harm to safety, the public welfare and the environment were not within the scope of this focused risk characterization

12.0 REFERENCES

1 Massachusetts Department of Environmental Protection, Letter, December 29, 2008.

2 Commonwealth of Massachusetts, Massachusetts Contingency Plan 310 CMR 40.000. Effective April 2006 and updates.

3 Tighe & Bond, Inc., Inc., Final Comprehensive Site Assessment for the Old Amherst Landfill, Amherst, MA. January 2008.

4 Commonwealth of Massachusetts, Technical Update: Background Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soil. May 2002.

5 Commonwealth of Massachusetts, MCP Toxicity.xls, 2008

6 USEPA 2008. Integrated Risk Information System, (http:// www.epa.gov/iris/search.htm)

7 USEPA, EPA Region III Risk Based Concentrations (Revision, 2006).

8 USEPA, EPA Region IX Risk Based Concentrations (Revision, 2004).

9 Commonwealth of Massachusetts, Guidance for Disposal Site Risk Characterization, July 1995.

10 Commonwealth of Massachusetts, Method 3 Risk Assessment for a Trespasser Exposed to Chemicals in Soil -- Shortform 2006 (sf06ts).

11 Commonwealth of Massachusetts, Technical Update: Weighted Skin-Soil Adherence Factors. April 2002.

ATTACHMENT A

Summary Compound Detection Statistics and Risk Results
For Fall Victims and Neighborhood Children Exposure Scenarios

Tables A-1 through A-5

Table A-1: Summary Compound Statistics – Sediment
Old Amherst Landfill, Amherst, MA

			Wetland		Wetland-Boardwalk		Wetland-Perimeter		Inlet to Gull Pond		
Compound	CAS #	Detection Frequency	Maximum Detected (mg/kg)	Mean Detected (mg/kg)	Maximum Detected (mg/kg)	Mean Detected (mg/kg)	Maximum Detected (mg/kg)	Mean Detected (mg/kg)	Maximum Detected (mg/kg)	Mean Detected (mg/kg)	BKGD (mg/kg)
Inorganics											
Arsenic	7440-38-2	18 / 22	260	47.3	87	70	30	10.6	130	72.7	ND
Cadmium	7440-43-9	6 / 16	11	3.1	6.4	5.2	4.5	1.3	---	---	ND

Wetland -- 16 samples: SED-6, SED-6A to SED-6L, SED-14, SED-16
Wetland-Boardwalk -- two samples: SED-6; highest detection along the boardwalk
Wetland-Perimeter -- 11 samples: SED-6A to SED-6J, SED-6L
Inlet to Gull Pond -- 6 samples: 3 SED-1 samples and SED-1A to SED-1C

Table A-2: Dose Response and Exposure Assumptions
Old Amherst Landfill -- Sediments along the KC Trail and the Inlet to Gull Pond

Compound	CSF (mg/(kg*d))$^{-1}$	Class	Ref	Chronic RfD (mg/(kg*d))	Ref	Subchronic RfD (mg/(kg*d))	Ref	RAF Soil-C_{oral}	RAF Soil-C_{der}
Arsenic	1.50E+00	A	I	3.00E-04	I	3.00E-04	D	1	0.03
Cadmium	NC	NC	NC	5.00E-04	I	5.00E-04	D	1	0.14

Receptor	Media	Route of Exposure	Exposure Frequency	Exposure Duration	Exposure Period	Ingestion Rate	Body Weight	Surface Area	Averaging Period (non-cancer)
Fall Victim									
Non-cancer (5 < 6 years old)	Sediment	Ingestion	1d/365 d	24hr/24hr	1 year	100 mg/d	19 kg	—	1 year
		Dermal	1d/365 d	24hr/24hr	1 year	—	19 kg	2779 cm^2	1 year
Cancer (5 < 12 years old)	Sediment	Ingestion	1d/365 d	24hr/24hr	7 years	50 mg/d	28 kg	—	70 years
		Dermal	1d/365 d	24hr/24hr	7 years	—	28 kg	3450 cm^2	70 years
Neighborhood Children									
Non-cancer (11 < 12 years old)	Sediment	Ingestion	60d/365 d	24hr/24hr	1 year	50 mg/d	40.3 kg	—	7 years
		Dermal	60d/365 d	24hr/24hr	1 year	—	40.3 kg	2477 cm^2	7 years
Cancer (11 < 18 years old)	Sediment	Ingestion	60d/365 d	24hr/24hr	7 years	50 mg/d	50.7 kg	—	70 years
		Dermal	60d/365 d	24hr/24hr	7 years	—	50.7 kg	2940 cm^2	70 years

Exposure Equations:

Ingestion

$ADD_{ingestion} = (EPC * IR * RAF * EF * ED * EP) / (BW * AP_{non\text{-}cancer})$

Dermal Contact

$ADD_{dermal} = (EPC * SA * AF * RAF * EF * ED * EP) / (BW * AP_{non\text{-}cancer})$

Note: See Table A-6 for exposure and dose-response values and definitions not included on this page.

Table A-3: Summary Risk Results
Old Amherst Landfill -- Sediments along the KC Trail and the Inlet to Gull Pond

Fall Victims	Non-Cancer	Risk?	Cancer	Risk?
EPCmaxavg	0.0078	N	1.8E-07	N

Neighborhood Children	Non-Cancer	Risk?	Cancer	Risk?
EPCmaxavg	0.24	N	4.9E-06	N

EPCs (mg/kg)	As	Cd	
maxavg	73	5.2	maximum average concentrations reflecting both inlet to pond and wetland-boardwalk
wetlands	47.3	3.1	averages over all samples collected from the wetland area
wetperimavg	10.6	1.3	average for samples collected around the perimeter of the wetland
wetboardwalk	70	5.2	maximum average concentration along wetland boardwalk (SED-6, KC Trail)
Gull Pond inlet	72.7	---	average over all samples collected from the Gull Pond inlet area

Exposure Assumptions		
Fall Victims	non-cancer:	5<6 years; IR - 1E-04 kg/d; SA - 2779 cm2/d; BW - 19 kg; 1d/y during one year
	cancer:	5<12 years; IR -- 5E-05 kg/d; SA - 3450 cm2/d; BW - 28 kg; 1d/y for 7 years over 70 years
Neighborhood Children	non-cancer:	11<12 years; IR -- 5E095 kg/d; SA - 2477 cm2/d; BW - 40.3 kg; 60 days over 6 months
	cancer:	11<18 years; IR 5E-05 kg/d; SA - 2940 cm2/d; BW - 50.7 kg; 60 d/y for 7 years over 70 years

Notes:	
Risk	exceeds non-cancer Hazard Index of one; exceeds Excess Lifetime Cancer Risk of 1E-05
EPC	exposure point concentrations for arsenic and cadmium
Arsenic (As)	cancer and non-cancer; site maximum reflects wetland area; max average reflects pond inlet
Cadmium (Cd)	non-cancer only; site maximum, wetland; max average, wetland-boardwalk; Cd not analyzed in inlet of pond
N	NO, does not exceed risk criterion
Y	YES, exceeds risk criterion

Table A-4: Hazard Index (HI) and Excess Lifetime Cancer Risk (ELCR)
for Fall Victims and Neighborhood Children in Sediments, Old Amerst Landfil, Amherst, MA

Fall Victim	HIing (Dimentionless)	HIder (Dimentionless)	HItot (Dimentionless)	% Total	ELCRing (Dimentionless)	ELCRder (Dimentionless)	ELCRtot (Dimentionless)	% Total
Arsenic	3.83E-03	3.19E-03	7.02E-03	89.7	5.84E-08	1.21E-07	1.79E-07	100.0
Cadmium	1.64E-04	6.39E-04	8.03E-04	10.3	---	---	---	---
TOTALS	0.0040	0.0038	0.0078	100	5.8E-08	1.2E-07	1.8E-07	100

Neighborhood Children	HIing (Dimentionless)	HIder (Dimentionless)	HItot (Dimentionless)	% Total	ELCRing (Dimentionless)	ELCRder (Dimentionless)	ELCRtot (Dimentionless)	% Total
Arsenic	8.60E-02	1.28E-01	2.14E-01	88.0	1.76E-06	3.11E-06	4.87E-06	100.0
Cadmium	3.69E-03	2.56E-02	2.93E-02	12.0	---	---	---	---
TOTALS	0.090	0.15	0.24	100	1.8E-06	3.1E-06	4.9E-06	100

HIing -- Hazard Index ingestion
HIder -- Hazard Index dermal
HItot -- Hazard Index total
ELCRing -- Excess Lifetime Cancer Risk ingestion
ELCRder -- Excess Lifetime Cancer Risk derman
ELCRtot -- Excess Lifetime Cancer Risk total

Table A-5: Dose and Exposure Assumptions and Definitions

Weighted Skin-Soil Adherence Factors (DEP, 2002)
*Guidance for Disposal Site Risk Charact*erization (DEP, 1995)
MCP Numerical Standards spreadsheets, MADEP 2008

Exposure Parameters

AF	--	Adherence Factors: Sediment -- 1 mg/cm^2
$AP_{(non\text{-}cancer)}$	--	Averaging Period - usually equal to exposure period (years)
$AP_{(cancer)}$	--	Averaging Period for lifetimeassumed to be 70 years
BW	--	Body weight (kg)
ED	--	Exposure Duration -- length of time per event
EF	--	Exposure Frequency -- frequency of events
EP	--	Exposure Period -- period during a lifetime
IR	--	Ingestion rate (based on soil ingestion studies)
[OHM]	--	EPC; Compound concentration in sediment; units consistent with toxicity reference values
RAF	--	Relative Absorbance Factor, specific for each compound by exposure route and duration;
SA	--	Surface area (cm^2)

Dose Response Parameters

Chx	Chronic value is used for the subchronic value
CSF	Cancer Slope Factor, oral and dermal
D	MCP Toxicity.xls, DEP, February 2008; and MADEP memo "Revisions to Dose Response...", August 18, 2
I	IRIS database; EPA 2008
NC	not a carcinogen by oral exposure
RAF	Relative Absorption Factors; MCP Toxicity xls, MADEP 2008
RfD	Reference Dose, oral and dermal

ATTACHMENT B

Toxicity Profiles

Arsenic (CAS# 7440-38-2)
Cadmium (CAS# 7440-43-9)

ATTACHMENT B

Toxicity Summary for ARSENIC CAS # 7440-38-2

ATSDR September 2005

Arsenic is an element that is widely distributed in the Earth's crust. Elemental arsenic is ordinarily a steel grey metal-like material that occurs naturally. However, arsenic is usually found in the environment combined with other elements such as oxygen, chlorine, and sulfur. Arsenic combined with these elements is called inorganic arsenic. Arsenic combined with carbon and hydrogen is referred to as organic arsenic. Understanding the difference between inorganic and organic arsenic is important because some of the organic forms are less harmful than the inorganic forms. Most inorganic and organic arsenic compounds are white or colorless powders that do not evaporate. They have no smell, and most have no special taste. Thus, you usually cannot tell if arsenic is present in your food, water, or air. Inorganic arsenic occurs naturally in soil and in many kinds of rock, especially in minerals and ores that contain copper or lead. When these ores are heated in smelters, most of the arsenic goes up the stack and enters the air as a fine dust. Smelters may compound called arsenic trioxide (As2O3). However, arsenic is no longer produced in the United States; all of the arsenic used in the United States is imported. Presently, about 90% of all arsenic produced is used as a preservative for wood to make it resistant to rotting and decay. The preservative is copper chromated arsenic (CCA) and the treated wood is referred to as "pressure-treated." In 2003, U.S. manufacturers of wood preservatives containing arsenic began a voluntary transition from CCA to other wood preservatives that do not contain arsenic in wood products for certain residential uses, such as play structures, picnic tables, decks, fencing, and boardwalks. This phase out was completed on December 31, 2003; however, wood treated prior to this date could still be used and existing structures made with CCA-treated wood would not be affected. CCA-treated wood products continue to be used in industrial applications. It is not known whether, or to what extent, CCA-treated wood products may contribute to exposure of people to arsenic. In the past, inorganic arsenic compounds were predominantly used as pesticides, primarily on cotton fields and in orchards. Inorganic arsenic compounds can no longer be used in agriculture. However, organic arsenic compounds, namely cacodylic acid, disodium methylarsenate (DSMA), and monosodium methylarsenate (MSMA), are still used as pesticides, principally on cotton. Some organic arsenic compounds are used as additives in animal feed. Small quantities of arsenic metal are added to other metals to form metal mixtures or alloys with improved properties. The greatest use of arsenic in alloys is in lead-acid batteries for automobiles. Another important use of arsenic compounds is in semiconductors and light-emitting diodes.

Arsenic occurs naturally in soil and minerals and it therefore may enter the air, water, and land from wind-blown dust and may get into water from runoff and leaching. Volcanic eruptions are another source of arsenic. Arsenic is associated with ores mined for metals, such as copper and lead, and may enter the environment during the mining and smelting of these ores. Small amounts of arsenic also may be released into the atmosphere from coalfired power plants and incinerators because coal and waste products often contain some arsenic. Arsenic cannot be destroyed in the environment. It can only change its form, or become attached to or separated from particles. It may change its form by reacting with oxygen or other molecules present in air, water, or soil, or by the action of bacteria that live in soil or sediment. Arsenic released from power plants and other combustion processes is usually attached to very small particles. Arsenic contained in wind-borne soil is generally found in larger particles. These particles settle to the ground or are washed out of the air by rain. Arsenic that is attached to very small particles may stay in the air for many days and travel long distances. Many common arsenic compounds can dissolve in water. Thus, arsenic can get into lakes, rivers, or underground water by dissolving in rain or snow or through the discharge of industrial wastes. Some of the arsenic will stick to particles in the water or sediment on the bottom of lakes or rivers, and some will be carried along by the water. Ultimately, most arsenic ends up in the soil or sediment. Although some fish and shellfish take in arsenic, which may build up in tissues, most of this arsenic is in an organic form called arsenobetaine (commonly called "fish arsenic") that is much less harmful.

Since arsenic is found naturally in the environment, you will be exposed to some arsenic by eating food, drinking water, or breathing air. Children may also be exposed to arsenic by eating dirt. You may also be exposed by skin contact with soil or water that contains arsenic. Analytical methods used by scientists to determine the levels of arsenic in the environment generally do not determine the specific form of arsenic present. Therefore, we do not always know the form of arsenic a person may be exposed to. Similarly, we often do not know what forms of arsenic are present at hazardous waste sites. Some forms of arsenic may be so tightly attached to particles or embedded in minerals that they are not taken up by plants and animals. The concentration of arsenic in soil varies widely, generally ranging from about 1 to 40 parts of arsenic to a million parts of soil (ppm) with an average level of 3–4 ppm. However, soils in the vicinity of arsenic-rich geological deposits, some mining and smelting sites, or agricultural areas where arsenic pesticides had been applied in the past may contain much higher levels of arsenic. The concentration of arsenic in natural surface andgroundwater is generally about 1 part in a billion parts of water (1 ppb), but may exceed 1,000 ppb in mining areas or where arsenic levels in soil are high. Groundwater is far more likely to contain high levels of arsenic than surface water. Surveys of U.S. drinking water indicate that about 80% of water supplies have less than 2 ppb of arsenic, but 2% of supplies exceed 20 ppb of arsenic. Levels of arsenic in food range from about 20 to 140 ppb.However, levels of inorganic arsenic, the form of most concern, are far lower. Levels of arsenic in the air generally range from less than 1 to about 2,000 nanograms (1 nanogram equals a billionth of a gram) of arsenic per cubic meter of air (less than 1–2,000 ng/m3), depending on location, weather conditions, and the level of industrial activity in the area. However, urban areas generally have mean arsenic levels in air ranging from 20 to 30 ng/m3.
You normally take in small amounts of arsenic in the air you breathe, the water you drink, and the food you eat. Of these, food is usually the largest source of arsenic. Seafood contains the greatest amounts of arsenic, but in fish and shellfish, this is mostly in an organic form of arsenic called arseonbetaine that is much less harmful. Some seaweeds may contain arsenic in inorganic forms that may be more harmful. Children are likely to eat small amounts of dust or dirt each day, so this is another way they may be exposed to arsenic. The total amount of arsenic you take in from these sources is generally about 50 micrograms (1 microgram equals one-millionth of a gram) each day. The level of inorganic arsenic (the form of most concern) you take in from these sources is generally about 3.5 microgram/day. In addition to the normal levels of arsenic in air, water, soil, and food, you could be exposed to higher levels in several ways, such as the following: • Some areas of the United States contain unusually high natural levels of arsenic in rock, and this can lead to unusually high levels of arsenic in soil or water. If you live in an area like this, you could take in elevated amounts of arsenic in drinking water. Children may be taking in arsenic because of hand to mouth contact or eating dirt. • Some hazardous waste sites contain large quantities of arsenic. If the material is not properly disposed of, it can get into surrounding water, air, or soil. If you live near such a site, you could be exposed to elevated levels of arsenic from these media. • If you work in an occupation that involves arsenic production or use (for example, copper or lead smelting, wood treating, pesticide application), you could be exposed to elevated levels of arsenic during your work. • If you saw or sand arsenic-treated wood, you could inhale some of the sawdust into your nose or throat. Similarly, if you burn arsenic-treated wood, you could inhale arsenic in the smoke. • If you live in a formerly agricultural area where arsenic was used on crops, the soil could contain high levels of arsenic. • In the past, several kinds of products used in the home (rat poison, ant poison, weed killer, some types of medicines) had arsenic in them. However, most of these uses of arsenic have ended, so you are not likely to be exposed from home products any longer.

If you swallow arsenic in water, soil, or food, most of the arsenic may quickly enter into your body. The amount that enters your body will depend on how much you swallow and the kind of arsenic that you swallow. This is the most likely way for you to be exposed near a waste site. If you breathe air that contains arsenic dusts, many of the dust particles settle onto the lining of the lungs. Most of the arsenic in these particles is then taken up from the lungs into the body. You might be exposed in this way near waste sites where arsenic-contaminated soils are allowed to blow into the air, or if you work with arsenic-containing soil or products. If you get arsenic-contaminated soil or water on your skin, only a small amount will go through your skin into your body, so this is usually not of concern. If you are exposed to arsenic, your liver changes some of this to a less harmful organic form. Both inorganic and organic forms leave your body in your urine. Most of the arsenic will be gone within several days, although some will remain in your body for several months or even longer.

Scientists use many tests to protect the public from harmful effects of toxic chemicals and to find ways for treating persons who have been harmed. One way to learn whether a chemical will harm people is to determine how the body absorbs, uses, and releases the chemical. For some chemicals, animal testing may be necessary. Animal testing may also help identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method for getting information needed to make wise decisions that protect public health. Scientists have the responsibility to treat research animals with care and compassion. Scientists must comply with strict animal care guidelines because laws today protect the welfare of research animals. Inorganic arsenic has been recognized as a human poison since ancient times, and large oral doses (above 60,000 ppb in food or water) can result in death. If you swallow lower levels of inorganic arsenic (ranging from about 300 to 30,000 ppb in food or water), you may experience irritation of your stomach and intestines, with symptoms such as stomachache, nausea, vomiting, and diarrhea. Other effects you might experience from swallowing inorganic arsenic include decreased production of red and white blood cells, which may cause fatigue, abnormal heart rhythm, blood-vessel damage resulting in bruising, and impaired nerve function causing a "pins and needles" sensation in your hands and feet. Perhaps the single-most characteristic effect of long-term oral exposure to inorganic arsenic is a pattern of skin changes. These include a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso, and are often associated with changes in the blood vessels of the skin. A small number of the corns may ultimately develop into skin cancer. Swallowing arsenic has also been reported to increase the risk of cancer in the liver, bladder, kidneys, prostate, and lungs. The Department of Health and Human Services (DHHS) has determined that inorganic arsenic is known to be a human carcinogen. The International Agency for Research on Cancer (IARC) has determined that inorganic arsenic is carcinogenic to humans. EPA also has classified inorganic arsenic as a known human carcinogen. If you breathe high levels of inorganic arsenic, then you are likely to experience a sore throat and irritated lungs. You may also develop some of the skin effects mentioned above. The exposure level that produces these effects is uncertain, but it is probably above 100 micrograms of arsenic per cubic meter (μg/m3) for a brief exposure. Longer exposure at lower concentrations can lead to skin effects, and also to circulatory and peripheral nervous disorders. There are some data suggesting that inhalation of inorganic arsenic may also interfere with normal fetal development, although this is not certain. An important concern is the ability of inhaled inorganic arsenic to increase the risk of lung cancer. This has been seen mostly in workers exposed to arsenic at smelters, mines, and chemical factories, but also in residents living near smelters and arsenical chemical factories. People who live near waste sites with arsenic may have an increased risk of lung cancer as well. If you have direct skin contact with inorganic arsenic compounds, your skin may become irritated, with some redness and swelling. However, it does not appear that skin contact is likely to lead to any serious internal effects. Despite all of the adverse health effects associated with inorganic arsenic exposure, there is some evidence that the small amounts of arsenic in the normal diet (10–50 ppb) may be beneficial to your health. For example, animals fed a diet with unusually low concentrations of arsenic did not gain frequently than animals fed a diet containing a normal amount of arsenic. Further, the babies of these animals tended to be smaller than normal, and some died at an early age. However, no cases of arsenic deficiency in humans have ever been reported. Almost no information is available on the effects of organic arsenic compounds in humans. Studies in animals show that most simple organic arsenic compounds (such as methyl and dimethyl compounds) are less toxic than the inorganic forms and that some complex organic arsenic compounds are virtually non-toxic. However, high doses can produce some of the same effects. Thus, if you are exposed to high doses of an organic arsenic compound, you might develop nerve injury, stomach irritation, or other effects, but this is not known for certain.

This section discusses potential health effects in humans from exposures during the period from conception to maturity at 18 years of age. Children are exposed to arsenic in many of the same ways that adults are. Since arsenic is found in the soil, water, food, and air, children may take in arsenic in the air they breathe, the water they drink, and the food they eat. Since children tend to eat or drink less of a variety of foods and beverages than do adults, ingestion of contaminated food or juice or infant formula made with arsenic-contaminated water may represent a significant source of exposure. In addition, since children often play in the dirt and put their hands in their mouths and sometimes intentionally eat dirt, ingestion of contaminated soil may be a more important source of arsenic exposure for children than for adults. In areas of the United States where natural levels of arsenic in the soil and water are high, or in areas in and around contaminated waste sites, exposure of children to arsenic through ingestion of soil and water may be significant. In addition, contact with adults who are wearing clothes contaminated with arsenic (e.g., with dust from copper- or lead smelting factories, from wood-treating or pesticide application, or from arsenic-treated wood) could be a source of exposure. Because of the tendency of children to taste things that they find, accidental poisoning from ingestion of pesticides is also a possibility. Thus, although most of the exposure pathways for children are the same as those for adults, children may be at a higher risk of exposure because of normal hand-to-mouth activity. Children who are exposed to arsenic may have many of the same effects as adults, including irritation of the stomach and intestines, blood vessel damage, skin changes, and reduced nerve function. Thus, all health effects observed in adults are of potential concern in children. There is also some evidence that suggests that long-term exposure to arsenic in children may result in lower IQ scores. We do not know if absorption of arsenic from the gut in children differs from adults. There is some information suggesting that children may be less efficient at converting inorganic arsenic to the less harmful organic forms. For this reason, children may be more susceptible to health effects from inorganic arsenic than adults. There is some evidence that inhaled or ingested arsenic can injure pregnant women or their unborn babies, although the studies are not definitive. Studies in animals show that large doses of arsenic that cause illness in pregnant females can also cause low birth weight, fetal malformations, and even fetal death. Arsenic can cross the placenta and has been found in fetal tissues. Arsenic is found at low levels in breast milk.

The federal government develops regulations and recommendations to protect public health. Regulations *can* be enforced by law. The EPA, the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA) are some federal agencies that develop regulations for toxic substances. Recommendations provide valuable guidelines to protect public health, but *cannot* be enforced by law. The Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH) are two federal organizations that develop recommendations for toxic substances. Regulations and recommendations can be expressed as "not-to-exceed" levels, that is, levels of a toxic substance in air, water, soil, or food that do not exceed a critical value that is usually based on levels that affect animals; they are then adjusted to levels that will help protect humans. Sometimes these not-to-exceed levels differ among federal organizations because they used different exposure times (an 8-hour workday or a 24-hour day), different animal studies, or other factors. Recommendations and regulations are also updated periodically as more information becomes available. For the most current information, check with the federal agency or organization that provides it. Some regulations and recommendations for arsenic include the following: The federal government has taken several steps to protect humans from arsenic. First, EPA has set limits on the amount of arsenic that industrial sources can release into the environment. Second, EPA has restricted or canceled many of the uses of arsenic in pesticides and is considering further restrictions. Third, in January 2001, the EPA lowered the limit for arsenic in drinking water from 50 to 10 ppb. Finally, OSHA has established a permissible exposure limit (PEL), 8-hour time-weighted average, of 10 μg/m3 for airborne arsenic in various workplaces that use inorganic arsenic. EPA chronic and subchronic reference dose (RfD) for oral and dermal lead exposures is 0.0003 mg/kg/day. The MADEP has adopted a chronic and subchronic reference concentration (RfC) of 2.5E-06 mg/m^3 for inhalation exposure to arsenic. EPA groups arsenic as a Class A carcinogen with a cancer slope factor (CSF) of 1.5 $(mg/kg/d)^{-1}$ and a unit risk value (UR) of 0.0043 $(ug/m^3)^{-1}$.

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop F-32
Atlanta, GA 30333
Phone: 888-422-8737; FAX: (770)-488-4178

ATTACHMENT B

Toxicity Summary for CADMIUM

Cd; CAS # 7440-43-9

ATSDR 1999

Cadmium is an element that occurs naturally in the earth's crust. Pure cadmium is a soft, silver white metal. Cadmium is not usually present in the environment as a pure metal, but as a mineral combined with other elements such as oxygen (cadmium oxide), chlorine (cadmium chloride), or sulfur (cadmium sulfate, cadmium sulfide). Cadmium is most often present in nature as complex oxides, sulfides, and carbonates in zinc, lead, and copper ores. It is rarely present in large quantities as the chlorides and sulfates. These different forms of cadmium compounds are solids that dissolve in water to varying degrees. The chlorides and sulfates are the forms that most easily dissolve in water. Cadmium may change forms, but the cadmium metal itself does not disappear from the environment. Knowing the particular form of cadmium, however, is very important when determining the risk of potential adverse health effects. Cadmium compounds are often found in or attached to small particles present in air. Most people can not tell by smell or taste that cadmium is present in air or water, because it does not have any recognizable taste or odor. Soils and rocks contain varying amounts of cadmium, generally in small amounts but sometimes in larger amounts (for example in some fossil fuels or fertilizers). Most cadmium used in the United States is extracted as a by-product during the production of other metals such as zinc, lead, or copper. Cadmium has many uses in industry and consumer products, mainly in batteries, pigments, metal coatings, plastics, and some metal alloys.

It is estimated that about 25,000 to 30,000 tons of cadmium are released to the environment each year, about half from the weathering of rocks into river water and then to the oceans. Forest fires and volcanoes also release some cadmium to the air. Release of cadmium from human activities is estimated at from 4,000 to 13,000 tons per year, with major contributions from mining activities, and burning of fossil fuels. Cadmium can enter the air from the burning of fossil fuels (e.g., coal fired electrical plants) and from the burning of household waste. Because of regulations, only small amounts currently enter water from the disposal of waste water from households or industries. Fertilizers often contain some cadmium that will enter the soil when fertilizers are applied to crops. Cadmium can also enter the soil or water from spills or leaks at hazardous waste sites if large amounts of dissolved cadmium are present at the site. The form of cadmium at these sites is important since many forms do not easily dissolve in water. Cadmium that is in or attached to small particles can enter the air and travel a long way before coming down to earth as dust, or in rain or snow. The cadmium metal itself does not break down in the environment, but it can change into different forms. Most forms of cadmium stay for a long time in the same place where they first entered the environment. Some forms of the cadmium that goes into the water will bind to soil, but some will remain in the water. Some forms of cadmium in soil can enter water or be taken up by plants. Fish, plants, and animals can take some forms of cadmium into their bodies from air, water, or food. Cadmium can change forms in the body, but it also stays in the body for a very long time (years).

Food and cigarette smoke are the biggest sources of cadmium exposure for people in the general population. Average cadmium levels in U.S. foods range from 2 to 40 parts of cadmium per billion parts of food (2-40 ppb). Lowest levels are in fruits and beverages, and highest levels are in leafy vegetables and potatoes. Air levels of cadmium in U.S. cities are low, ranging from less than I to 40 nanograms per cubic meter (ng/m3) (a nanogram is one billionth of a gram). Air levels greater than 40 ng/m3 may occur in urban areas with high levels of air pollution from the burning of fossil fuels. The level of cadmium in most drinking water supplies is less than 1 ppb, well below the drinking water standard of 50 ppb. Levels in drinking water, however, may vary greatly depending on local conditions. The average level of cadmium in unpolluted soil is about 250 ppb. At hazardous waste sites, cadmium levels have been measured in soil at about 4 parts cadmium per million parts (4 ppm; a part per million is 1,000 times more than a ppb) and in water at 6 ppm. In the United States, the average person eats food with about 30 micrograms (µg) of cadmium in it each day, but only about 1-3 μg per day of that cadmium from food is absorbed and enters the body. Cadmium exposure from smoking cigarettes may be a more serious health concern than cadmium in food. Smokers may double their daily intake of cadmium compared with nonsmokers. Each cigarette may contain from 1 to 2 μg of cadmium, and 40-60% of the cadmium in the inhaled smoke can pass through the lungs into the body. This means that smokers may take in an additional 1-3 μg of cadmium into their body per day from each pack of cigarettes smoked. Smoke from other people's cigarettes probably does not cause non-smokers to take in much cadmium. Aside from tobacco smokers, people who live near hazardous waste sites or factories that release cadmium into the air have the potential for exposure to cadmium in air. However, numerous state and federal regulations control the amount of cadmium that can be released to the air from waste sites and incinerators so that properly regulated sites are not hazardous. The general population and people living near hazardous waste sites may be exposed to cadmium in contaminated food, dust, or water from unregulated releases or accidental releases. Numerous regulations and use of pollution controls are enforced to prevent such releases. Workers can be exposed to cadmium in air from the smelting and refining of metals, or from the air in plants that make cadmium products such as batteries, coatings, or plastics. Workers can also be exposed when soldering or welding metal that contains cadmium. Approximately 512,000 workers in the United States are in environments each year where a cadmium exposure may occur. Regulations that set permissible levels of exposure, however, are enforced to protect workers and to make sure that levels of cadmium in the air are considerably below levels thought to result in harmful effects.

Cadmium can enter your body from the food you eat, the water you drink, from particles it may be attached to in the air you breathe, or from breathing in cigarette smoke that contains cadmium. Higher amounts of cadmium can enter your body from the cadmium in air or smoke that you inhale (25 to 60% of the cadmium present) than from cadmium in foods you eat (about 5-10% enters the body). The cadmium not taken into your body through the lungs is breathed out. The cadmium not taken into your body from food or water leaves your body in feces. If you do not eat foods that contain enough iron or other nutrients, you are likely to take up more cadmium from your food than usual. Virtually no cadmium enters your body through your skin. Most of the cadmium that enters your body goes to your kidney and liver and can remain there for many years. A small portion of the cadmium that enters your body leaves slowly in urine and feces. Your body can change most cadmium to a form that is not harmful, but too much cadmium can overload the ability of your liver and kidney to change the cadmium to a harmless form, and the harmful form may damage your health.

The potential for cadmium to harm your health depends upon the form of cadmium present, the amount taken into your body, and whether the cadmium is eaten or breathed. There are no known good effects from taking in cadmium. Breathing air with very high levels of cadmium can severely damage the lungs and may cause death. Breathing air with lower levels of cadmium over long periods of time (for years) results in a build-up of cadmium in the kidney, and if sufficiently high, may result in kidney disease. Other effects that may occur after breathing cadmium for a long time are lung damage and fragile bones. To protect the public from the harmful effects of toxic chemicals and to find ways to treat people who have been harmed, scientists use many tests. One way to see if a chemical will hurt people is to learn how the chemical is absorbed, used, and released by the body; for some chemicals, animal testing may be necessary. Animal testing may also be used to identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method to get information needed to make wise decisions to protect public health. Scientists have the responsibility to treat research animals with care and compassion. Laws today protect the welfare of research animals, and scientists must comply with strict animal care guidelines. We do not have many good studies on the health effects of cadmium in people. Exposures to cadmium throughout most of the world are currently regulated so there are relatively few people receiving high levels, and the effects from long-term low-level exposure to cadmium are hard to determine with the many other factors that can come into play. A number of studies on workers exposed to cadmium in the air have not resulted in convincing evidence that cadmium can cause lung cancer in humans. In animals studies, mice or hamsters that breathed in cadmium did not get lung cancer, but rats that breathed in cadmium did develop lung cancer. There is no good information on people to suggest that breathing cadmium can affect your ability to have children. Female rats and mice, however, that breathed high levels of cadmium had fewer litters, and their babies may have had more birth defects than usual. Breathing cadmium has also been shown to cause liver damage and changes in the immune system in rats and mice. There is no reliable information on people to indicate that breathing cadmium harms peoples' liver, heart, nervous system, or immune system. Eating food or drinking water with very high cadmium levels severely irritates the stomach, leading to vomiting and diarrhea, and sometimes death. Eating lower levels of cadmium over a long period of time can lead to a build-up of cadmium in the kidneys. If the levels reach a high enough level, the cadmium in the kidney will cause kidney damage, and also causes bones to become fragile and break easily. We do not have good direct information from people who have been exposed to cadmium to know if eating cadmium at levels, below which other toxic effects are not seen, might effect your ability to have children. Animals eating or drinking cadmium sometimes get high blood pressure, iron-poor blood, liver disease, and nerve or brain damage. We have no good information on people to indicate that the levels that people would need to eat or drink cadmium to result in these diseases, or if they would occur at all. Studies of humans or animals that eat or drink cadmium have not found increases in cancer, although additional research is needed to be more certain that eating or drinking cadmium definitely does or does not cause cancer. Skin contact with cadmium is not known to affect the health of people or animals because virtually no cadmium can enter the body through the skin under normal circumstances (i.e., without exposure to very high concentrations for long times or exposure to skin that was not damaged). As a conservative approach, and based on the limited human data and the studies in rats, the United States Department of Health and Human Services (DHHS) has determined that cadmium and cadmium compounds may reasonably be anticipated to be carcinogens. The International Agency for Research on Cancer (IARC) has determined that cadmium is carcinogenic to humans. The EPA has determined that cadmium is a probable human carcinogen by inhalation.

This section discusses potential health effects from exposures during the period from conception to maturity at 18 years of age in humans. Potential effects on children resulting from exposures of the parents are also considered. The health effects seen in children from exposure to toxic levels of cadmium are expected to be similar to the effects seen in adults (kidney, lung, and intestinal damage depending on, the route of exposure). These effects are most easily seen in short-term high-level exposures. Harmful effects on child development or behavior have not generally been seen in populations exposed to cadmium, but more research is needed. It is also difficult to determine the cause of harmful effects on child behavior or development from exposures to low levels over long periods of time, which are the most likely exposures for children as well adults in the general population. We do not know whether cadmium can cause birth defects in people. Studies in animals exposed to high enough levels of cadmium during pregnancy have resulted in harmful effects in the young. The nervous system appears to be the most sensitive target. Young animals exposed to cadmium before birth have shown effects on behavior and learning. There is also some information from animal studies that high enough exposures to cadmium before birth can reduce body weights and affect the skeleton in the developing young. Similar effects, however, have not been observed in humans. Humans may respond differently or the exposure levels in humans may be considerably below the levels that produced these adverse effects in animals. More research on human health effects is needed to answer these questions. Most cadmium taken into the stomach and intestines passes through without being absorbed. At high enough levels, however, damage to the stomach and intestines can occur. A few studies in animals indicate that younger animals absorb more cadmium than adults. Animal studies also indicate that the young are more susceptible than adults to a loss of bone and decreased bone strength from exposure to cadmium. Animal studies also indicate that more cadmium is absorbed into the body from the diet if the diet is low in calcium, protein, or iron, or if the diet is high in fat (because fat slows down the passage of food in the gut and allows more time for absorption). Children who do not get enough iron, calcium, or protein may also absorb more cadmium. Women with low levels of calcium or iron, due to multiple pregnancies and/or dietary deficiencies, may also absorb more cadmium when exposed to cadmium in food or water. Cadmium does not readily go from a pregnant woman's body into the developing child, but some can cross the placenta. Cadmium levels in human milk can also be from 5 to 10% of the levels found in the mother's blood.

Some regulations and recommendations for cadmium include the following: The government has taken steps to protect humans from excessive cadmium exposure. The EPA allows only up to 5 parts of cadmium per billion parts of water (5 ppb) in drinking water. The EPA also limits how much cadmium can be put into lakes, rivers, dumps, and cropland, and does not allow cadmium in pesticides. The FDA limits the amount of cadmium in food colors to 15 parts per million (ppm). OSHA now limits the amount of cadmium in workplace air to 5 micrograms per cubic meter (μg/m3). EPA chronic and subchronic reference dose

ATTACHMENT B

(RfD) for oral and dermal cadmium exposures is 0.0005 mg/kg/d. Chronic and subchronic reference concentration (RfC) for inhalation exposure is 0.00002 mg/m^3. Cadmium is a Class B1 carcinogen by inhalation. The Unit risk value is 0.0018 $(ug/m^3)^{-1}$

Agency for Toxic Substances and Disease Registry, Division of Toxicology
1600 Clifton Road NE, Mailstop E-29; Atlanta, GA 30333
Phone: 1-800-447-1544; Fax: (404) 639-6359